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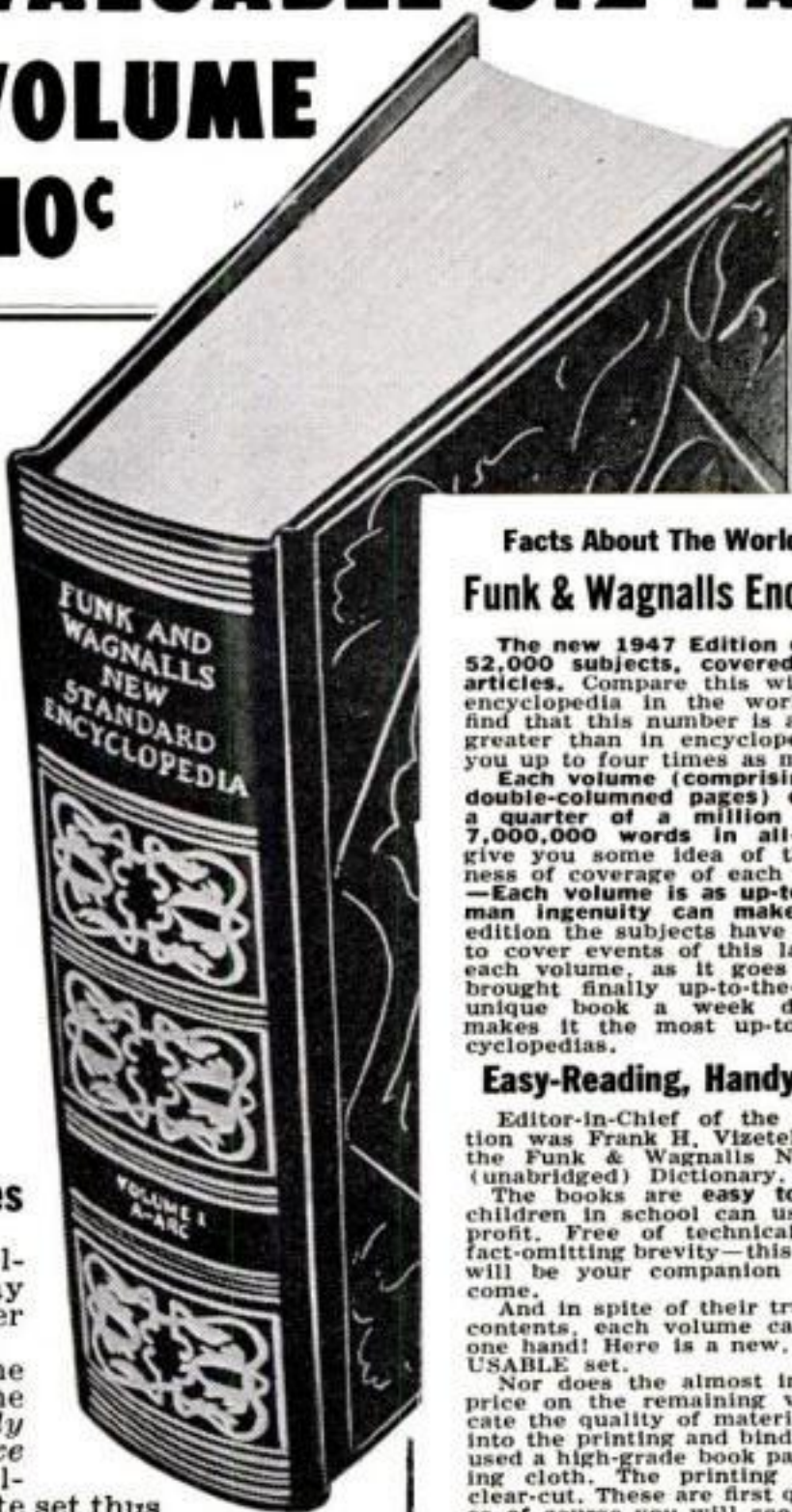
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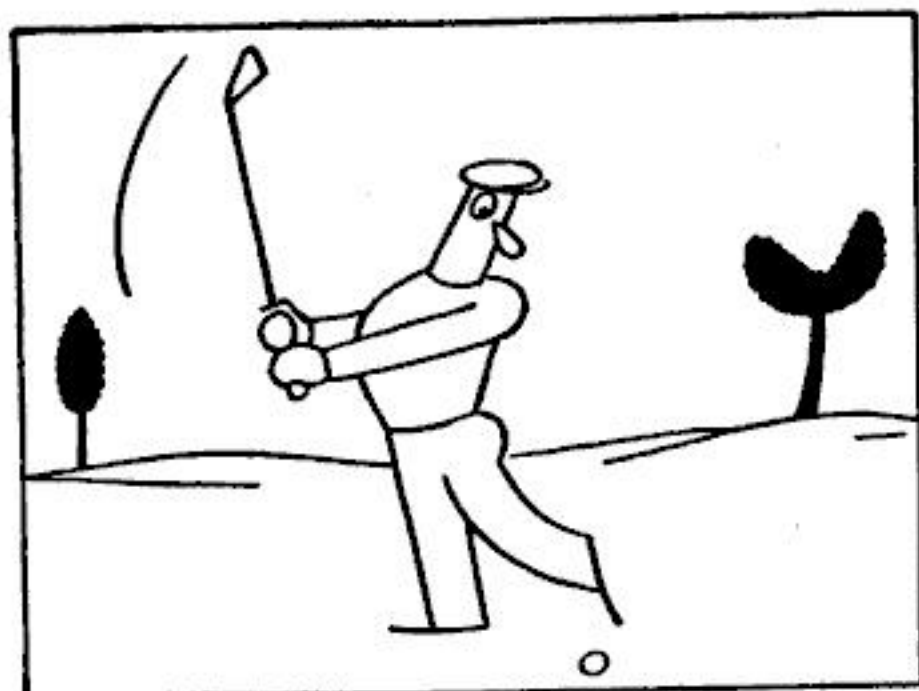
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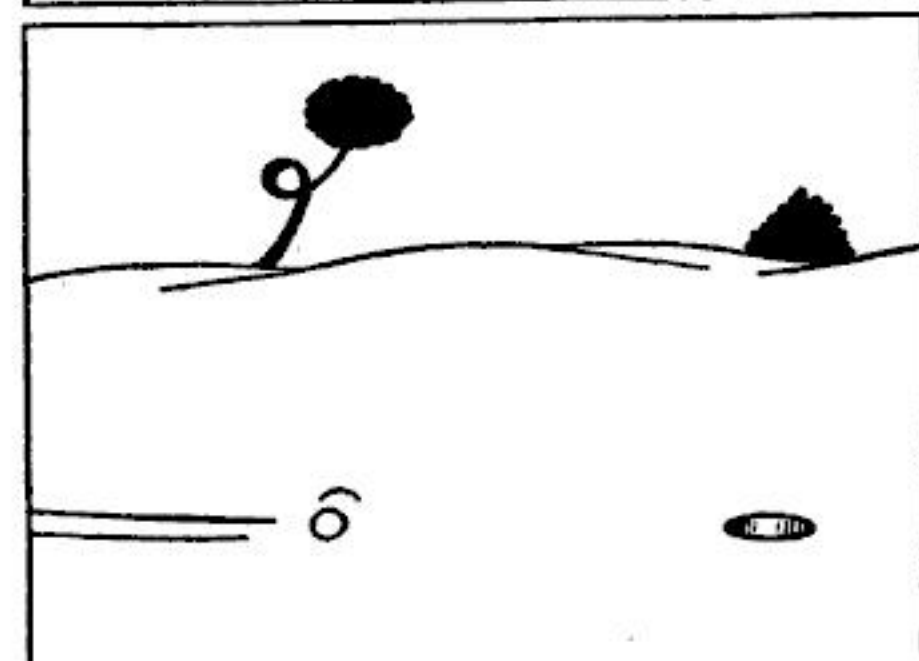
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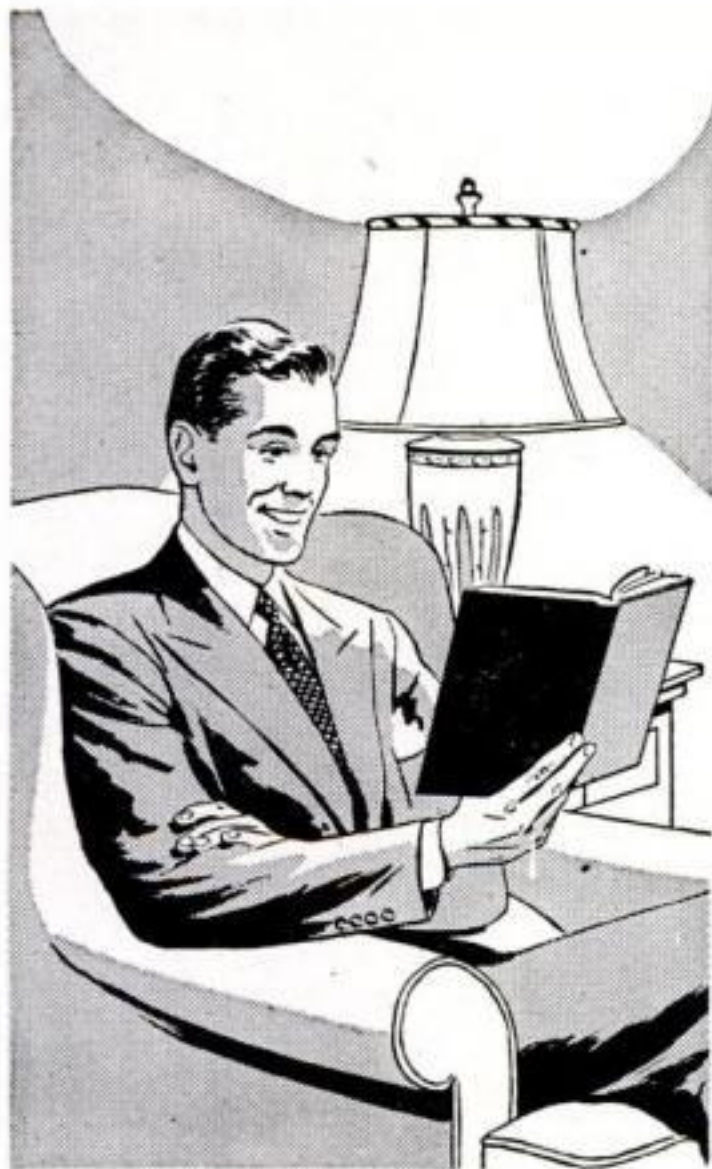
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| <input type="checkbox"/> Surveying and Mapping                               |                                      |
| <input type="checkbox"/> Communications Courses                              |                                      |
| <input type="checkbox"/> Electronics   |                                      |
| <input type="checkbox"/> Practical Telephony                                 |                                      |
| <input type="checkbox"/> Radio, General                                      |                                      |
| <input type="checkbox"/> Radio Operating                                     |                                      |

### Radio Servicing

### Telegraph Engineering

### Electrical Courses

- |   |
|---|
| <input type="checkbox"/> Electrical Drafting      |
| <input type="checkbox"/> Electrical Engineering   |
| <input type="checkbox"/> Electric Light and Power |
| <input type="checkbox"/> Lighting Technician      |
| <input type="checkbox"/> Practical Electrician    |
| <input type="checkbox"/> Power House Electric     |
| <input type="checkbox"/> Ship Electrician         |

### Internal Combustion Engines Courses

- |  |                                      |
|--|--------------------------------------|
| <input type="checkbox"/> Auto Technician | <input type="checkbox"/> Aviation    |
| <input type="checkbox"/> Diesel-Electric |                                      |
| <input type="checkbox"/> Diesel Engines  | <input type="checkbox"/> Gas Engines |

### Mechanical Courses

- |   |                                       |
|---|---------------------------------------|
| <input type="checkbox"/> Aeronautical Engineer's, Jr. | <input type="checkbox"/> Foundry Work |
| <input type="checkbox"/> Aircraft Drafting            |                                       |
| <input type="checkbox"/> Flight Engineer              |                                       |
| <input type="checkbox"/> Forging                      |                                       |
| <input type="checkbox"/> Heat Treatment of Metals     |                                       |
| <input type="checkbox"/> Industrial Engineering       |                                       |
| <input type="checkbox"/> Industrial Metallurgy        |                                       |
| <input type="checkbox"/> Machine Shop                 |                                       |
| <input type="checkbox"/> Machine Shop Inspection      |                                       |

### Mechanical Drafting

- |  |  |
|--|--|
| <input type="checkbox"/> Mechanical Engineering    | <input type="checkbox"/> Ship Fitting      |
| <input type="checkbox"/> Mold-Loft Work            | <input type="checkbox"/> Toolmaking        |
| <input type="checkbox"/> Patternmaking—Wood, Metal |  |
| <input type="checkbox"/> Reading Shop Blueprints   |  |
| <input type="checkbox"/> Sheet-Metal Drafting      |  |
| <input type="checkbox"/> Sheet-Metal Worker        |  |
| <input type="checkbox"/> Ship Drafting             |  |
| <input type="checkbox"/> Tool Designing            |  |
| <input type="checkbox"/> Welding—Gas and Electric  |  |
| <input type="checkbox"/> Railroad Courses          |  |
| <input type="checkbox"/> Air Brake                 | <input type="checkbox"/> Car Inspector     |
| <input type="checkbox"/> Diesel Locomotive         |  |
| <input type="checkbox"/> Locomotive Engineer       |  |
| <input type="checkbox"/> Locomotive Fireman        |  |
| <input type="checkbox"/> Railroad Section Foreman  |  |
| <input type="checkbox"/> Steam Engineering Courses |  |
| <input type="checkbox"/> Boilermaking              |  |
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| <input type="checkbox"/> Steam Electric            |  |
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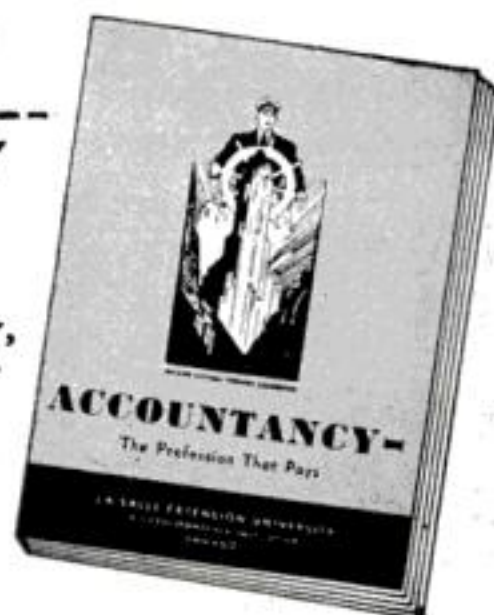
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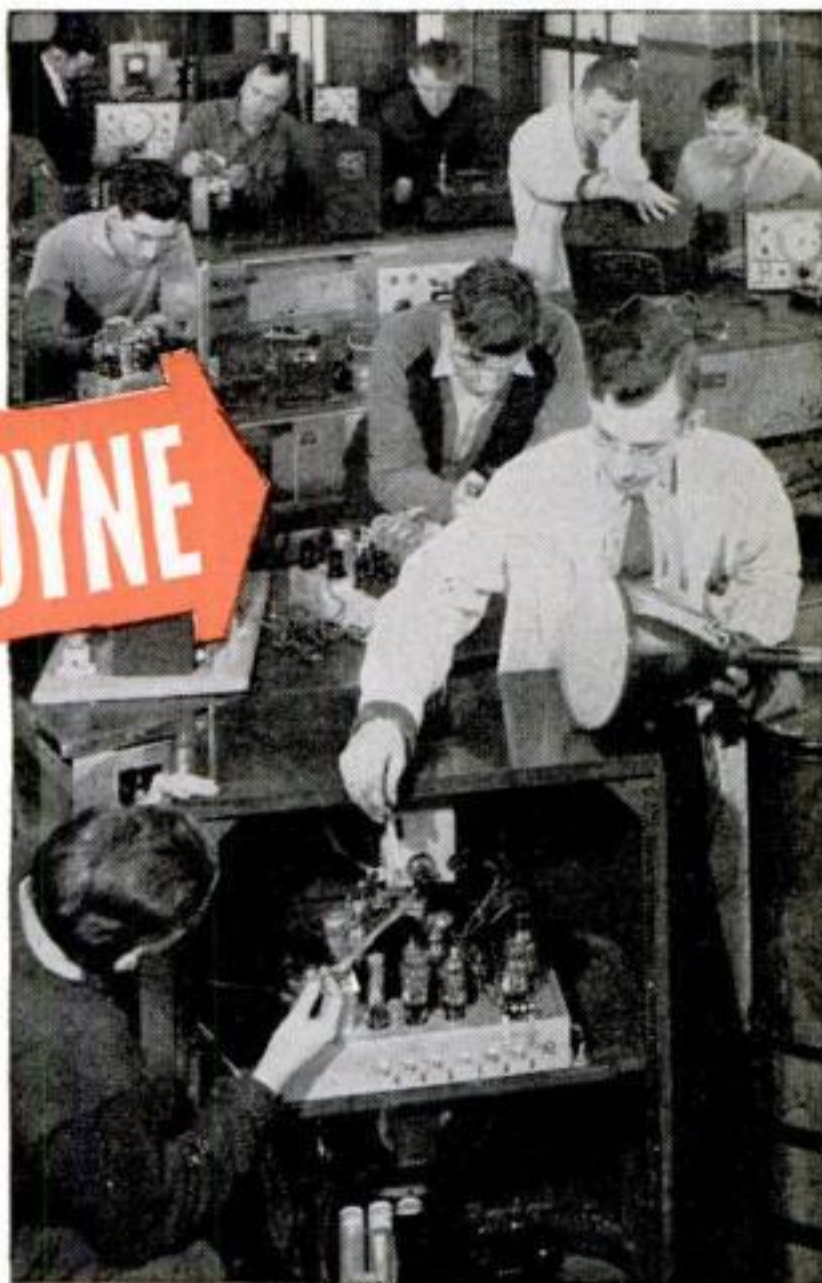
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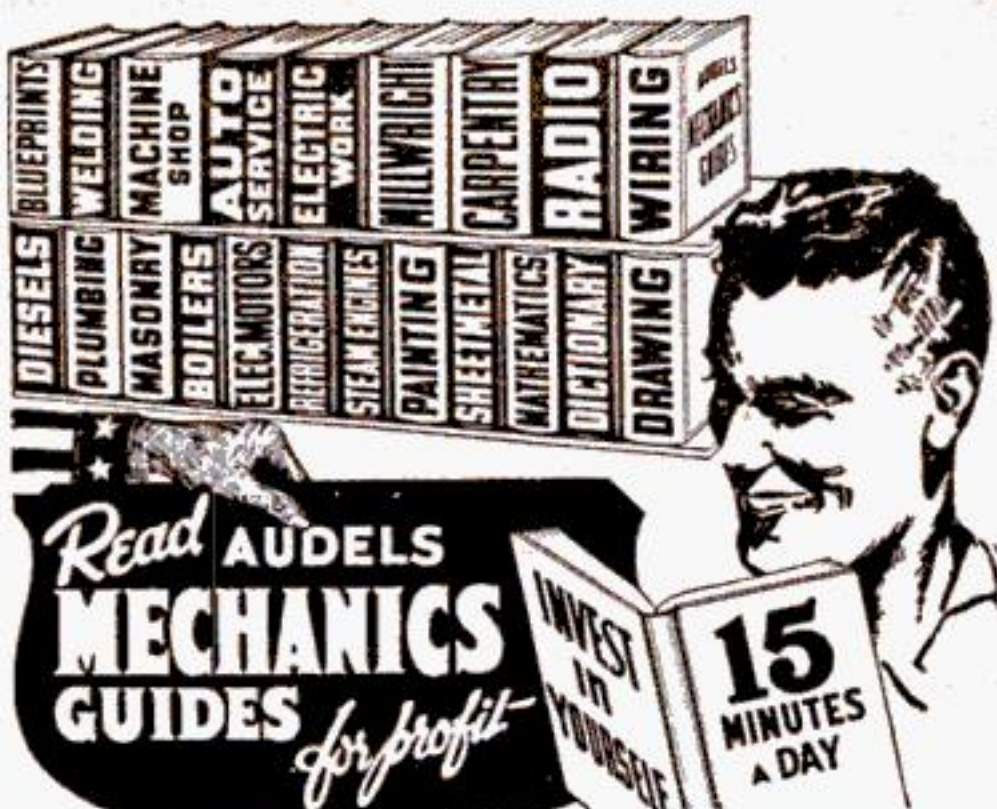
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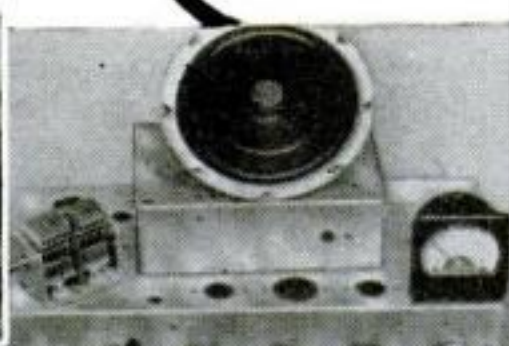
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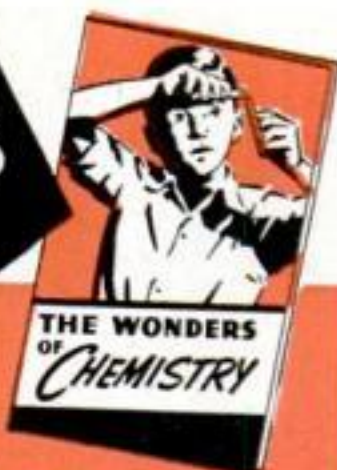


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## LETTERS

### Wrong Rocket

Sir:

The rocket taking off on page 124 of the September issue, called a V-2, is actually a Wac Corporal, which takes off with the aid of a booster rocket. The booster is indicated by the black, smoky flame characteristic of powder boosters. . . .

JAMES STOCKARD

Nashville, Tenn.

*PSM, which can usually tell the difference between a V-2 and a Wac Corporal, pleads an apologetic guilty. The rocket in the picture is indeed a Wac Corporal.*

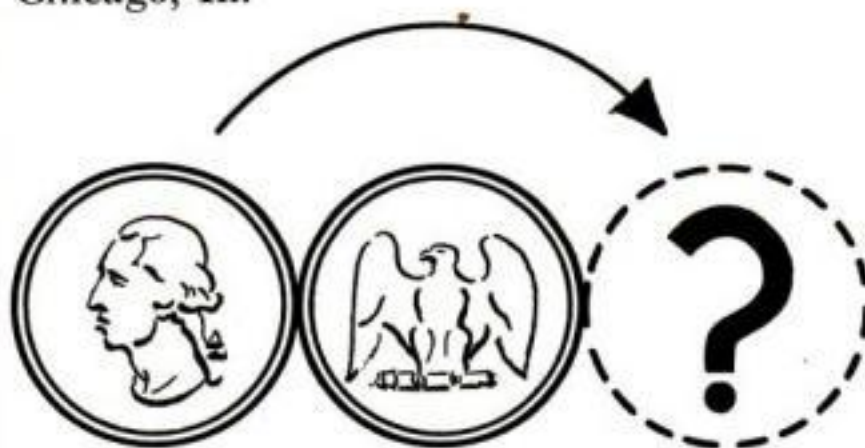
### Heads Up!

Sir:

Two similar coins are made to touch as shown below. If the right-hand one is held stationary while the left is rotated around it to the position indicated by the question mark, will the head on the coin then be right side up or upside down?

ARTHUR M. LANDIS

Chicago, Ill.



*Although the moving coin travels only half way around the stationary one, it makes a complete revolution, landing right side up. Why? Well, in addition to rolling half the circumference of the stationary coin, the moving coin at the same time makes half a revolution around the other. It thus makes half the revolution around its own axis and half around the stationary coin—and two halves make a whole.*



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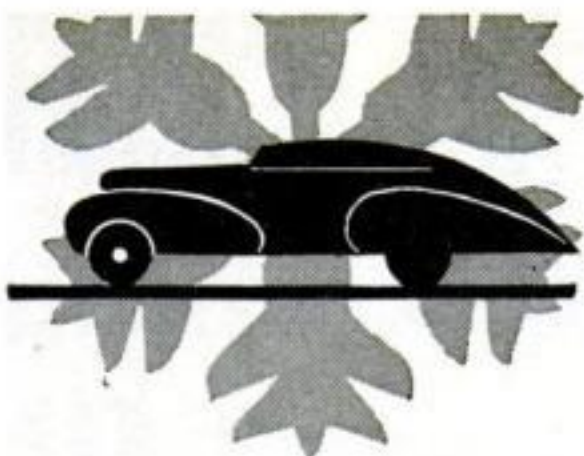
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*Jerry, the talking dog, is entertaining hospitalized veterans, by courtesy of the PYROIL Company. Picture of Jerry sent on request.*

## A Matter of Opinion

Sir:

In your June issue, you stated that the parachute landing pictured on page 89 was as perfect as any illustrated. If I had landed like the illustration shows when I went through jump school, I and anyone else would have been lucky to come out without any broken bones, and if I had been seen by a jump instructor, I would still be doing push-ups. . . .

The elbows should be turned in instead of out as in picture No. 2. This is so the jumper won't break his arms. Also, the jumper shown has landed on feet, buttocks and back. This would result in a back injury and possible pelvis fracture. The proper landing consists of five contact points: the balls of the feet, the calf of the leg, the thigh, the buttocks, and the push-up muscle. The feet take up 30% of the shock, and the rest is evenly distributed along the body. The feet should be together at all times. . . .

A Parachute Infantry Corporal  
Fort Bragg, N. C.

*PSM is at least partially exonerated by Col. David G. Erskine, of the Army Ground Forces, whose reply to the corporal follows. All concerned, however, seem to agree that the pictures could have been better.*

Sir:

. . . Your reader is wrong in stating that 30% of the shock is absorbed on the balls of the feet; 40% is the correct figure. To state that the jumper is striking the wrong points of contact would be conjecture because illustration No. 2 is not sufficiently clear to determine this fact. Whether the jumper's feet are apart because of the force with which he hit the ground or simply as the result of a poor landing position is also conjecture since the photographs do not cover the entire landing sequence.

Picture No. 1 is a good example of proper landing attitude. Picture No. 2 is incorrect in these features: (a) The jumper should have his elbows down in front of his face. (b) His feet and legs should be together. Picture No. 3 is incorrect if the man is still in the process of completing his fall. (a) He should have his feet together. (b) His elbows should be in front of his face.

COL. DAVID G. ERSKINE  
Headquarters Army Ground Forces  
Washington, D. C.



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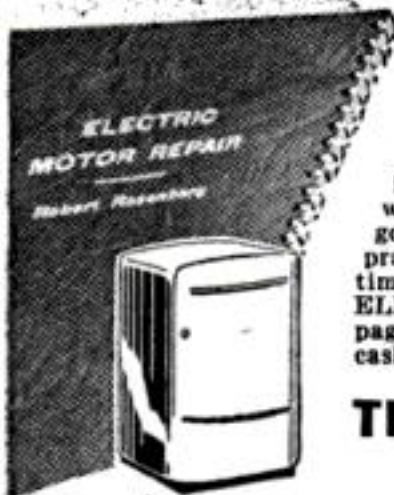
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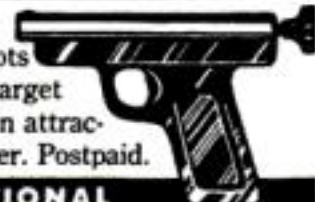
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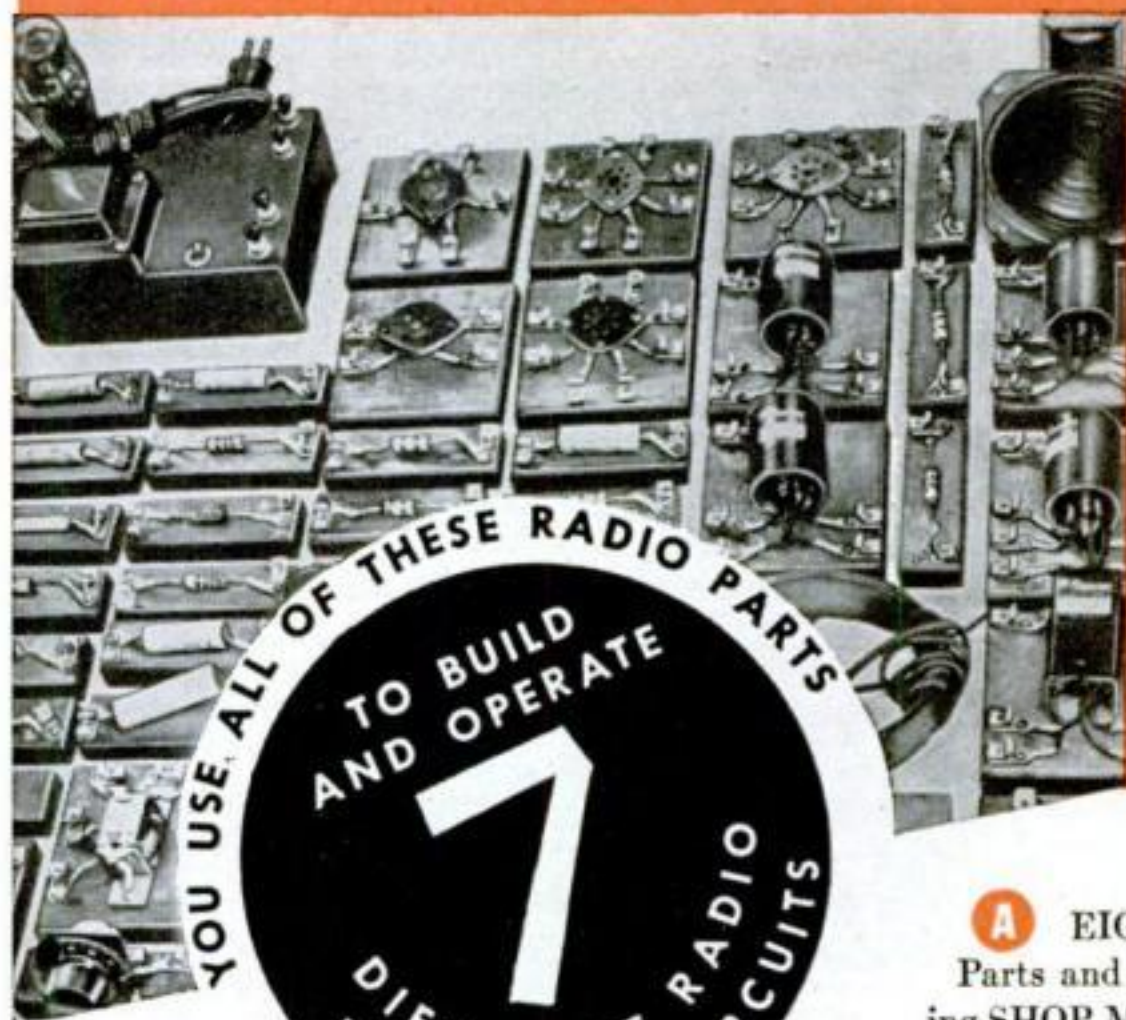
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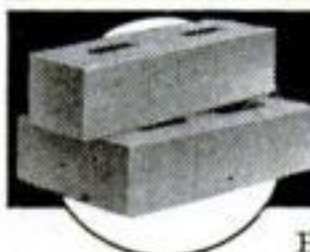
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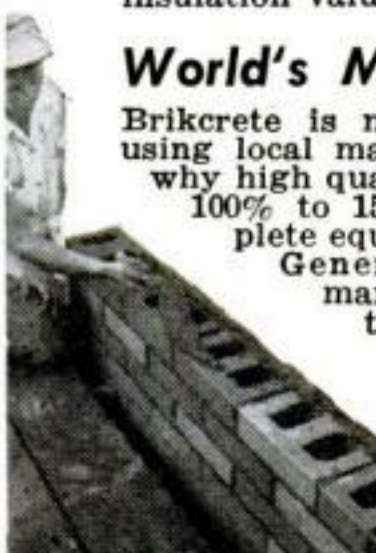


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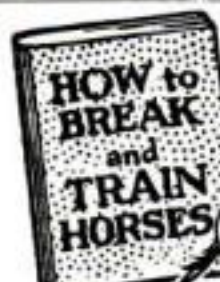
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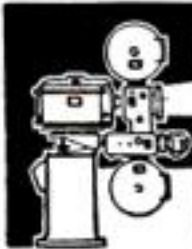
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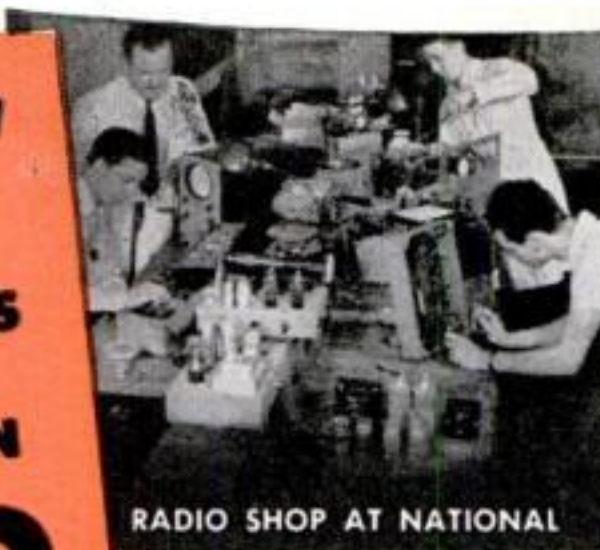


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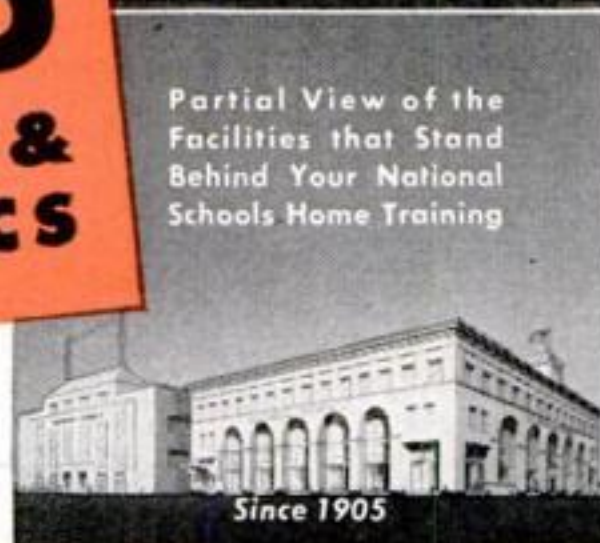
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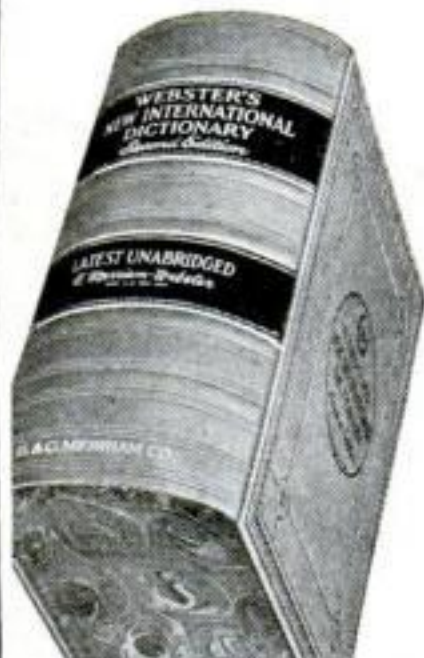
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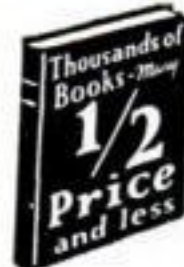


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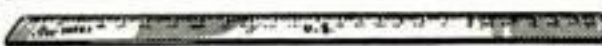


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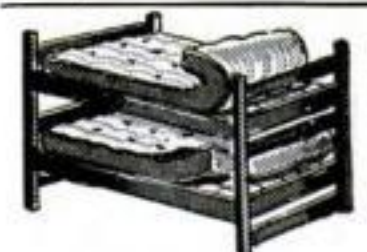
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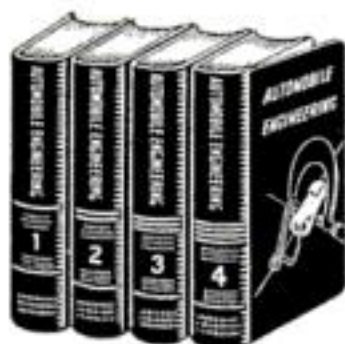
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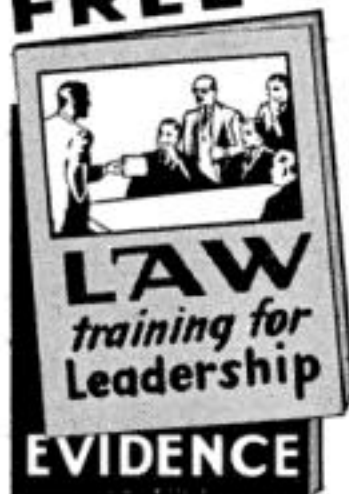
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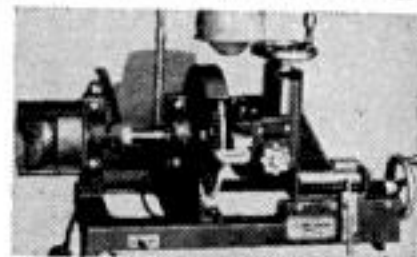
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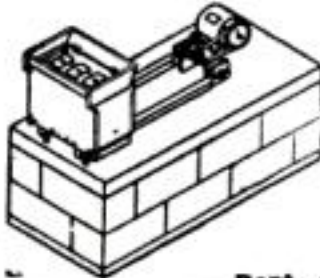
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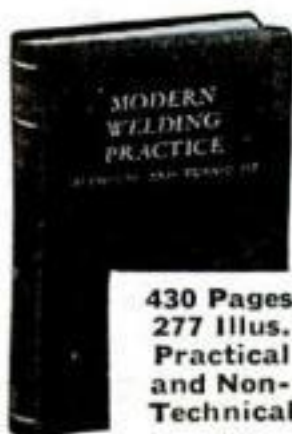
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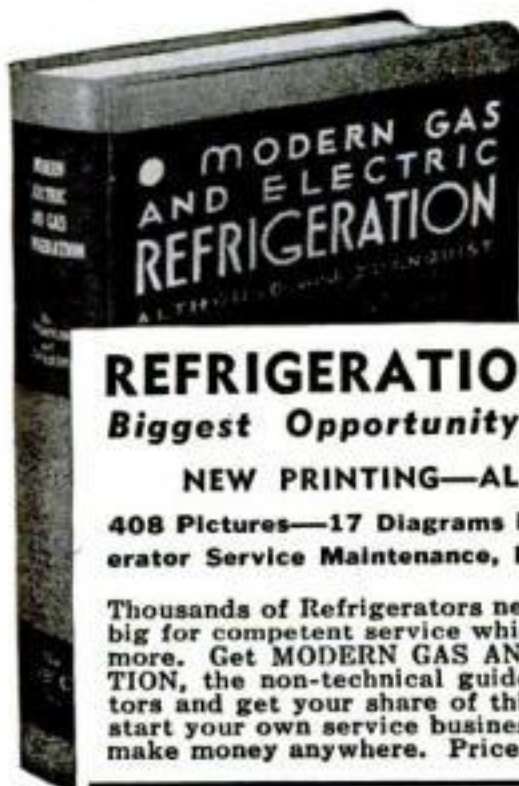
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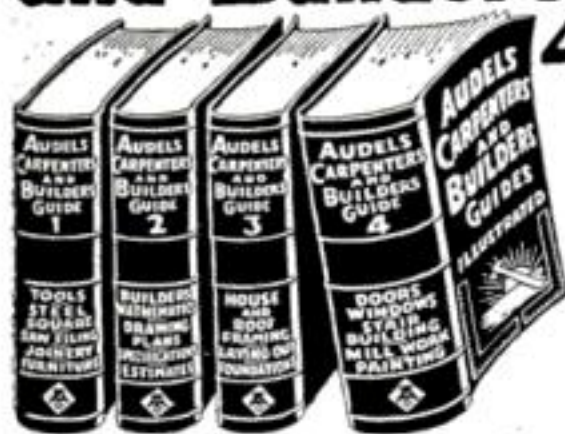
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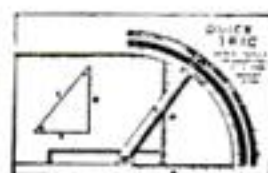
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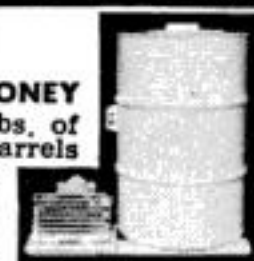
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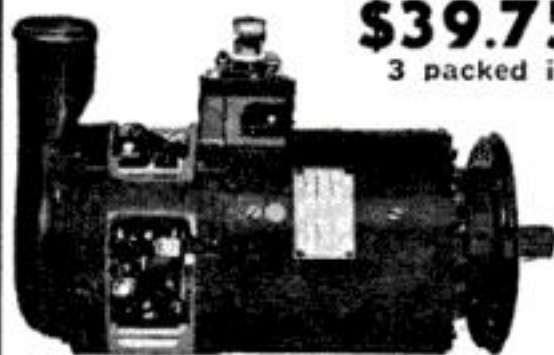
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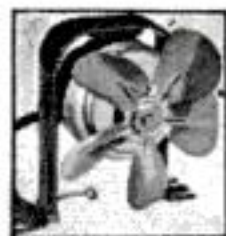
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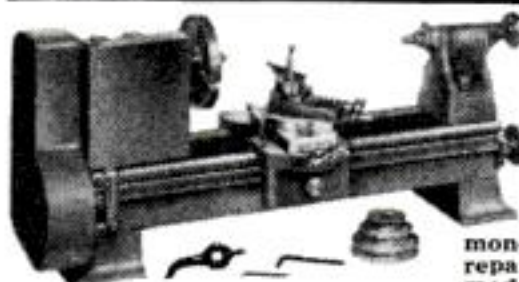
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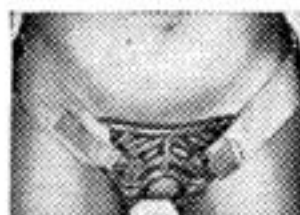
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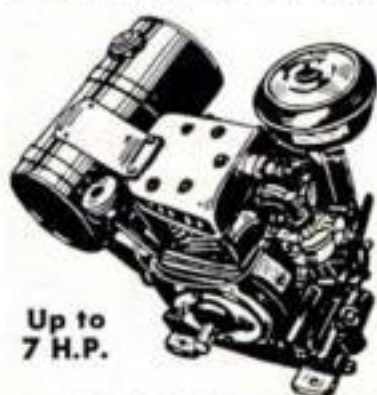
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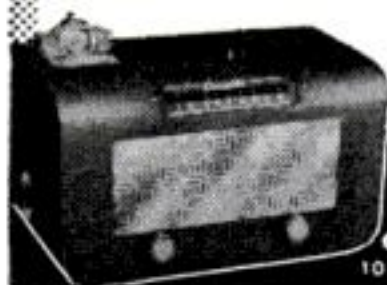
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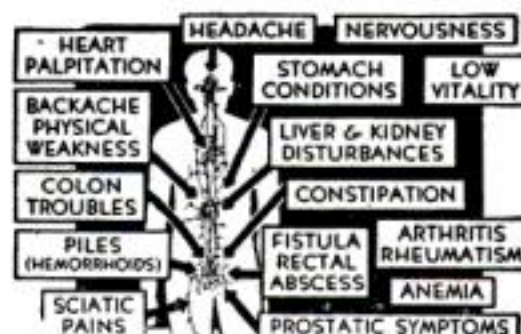
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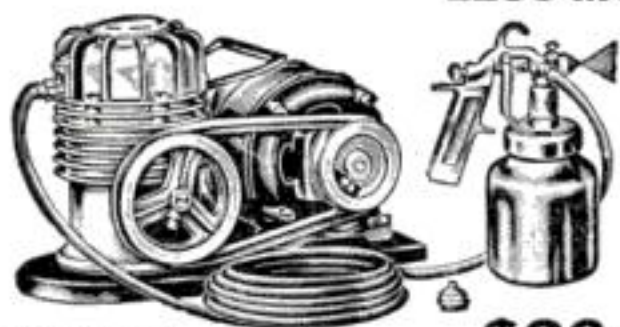
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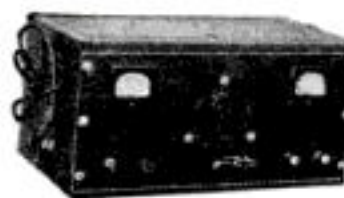
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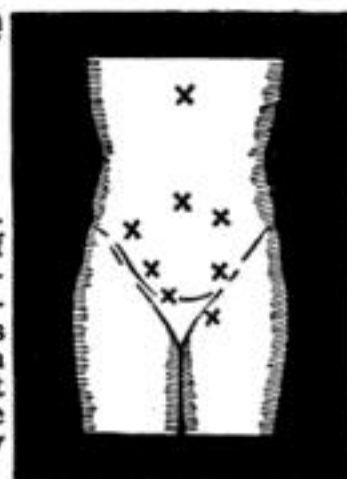
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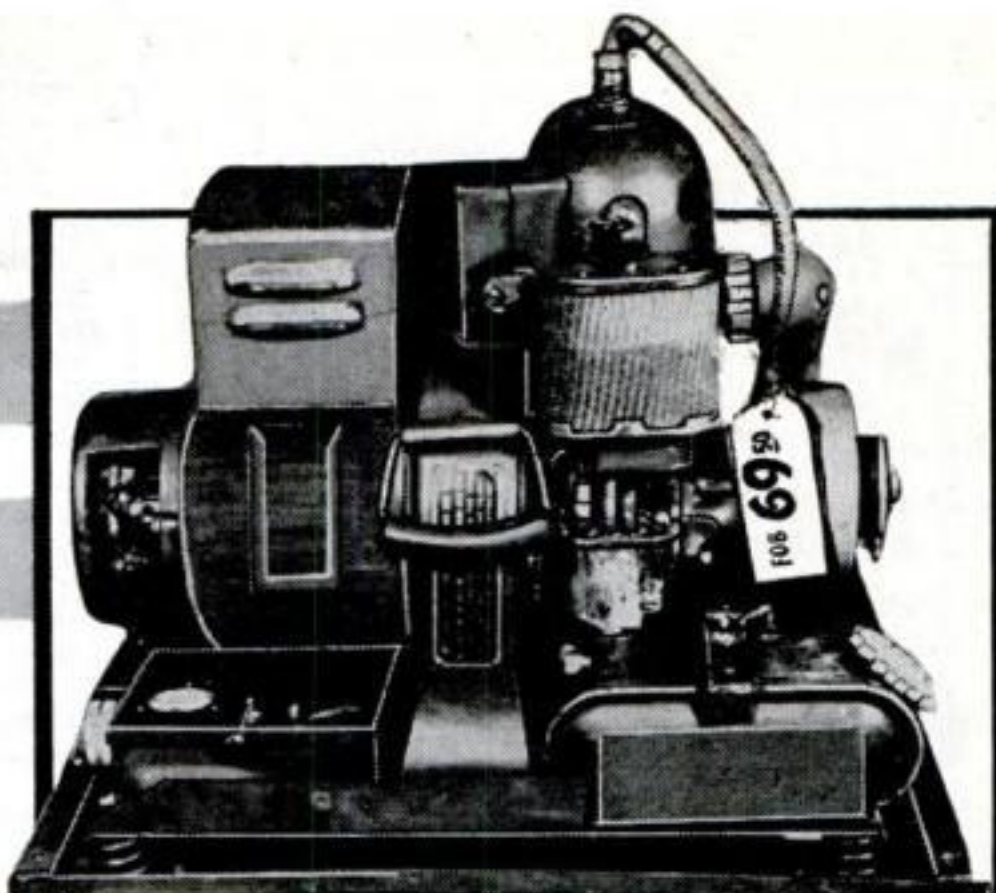
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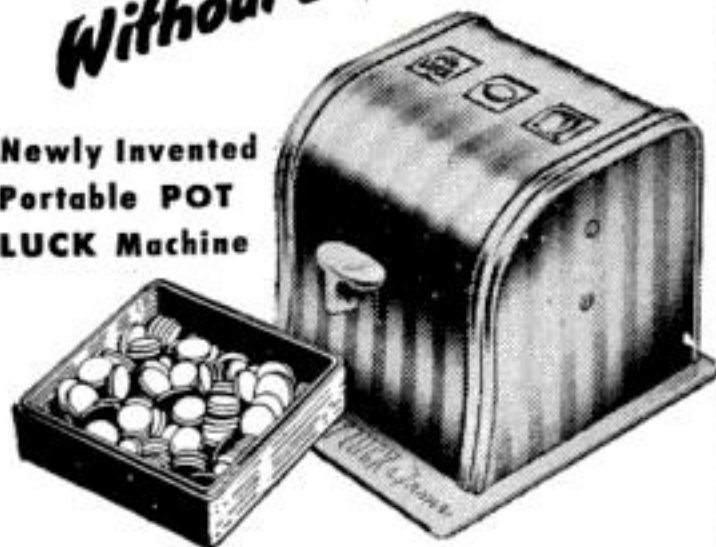
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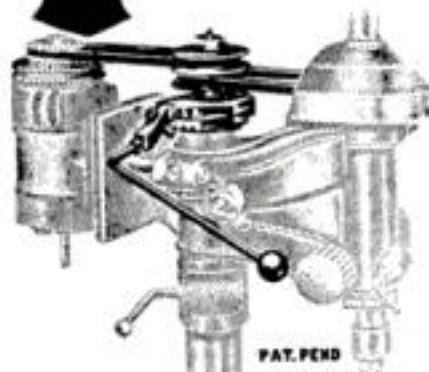


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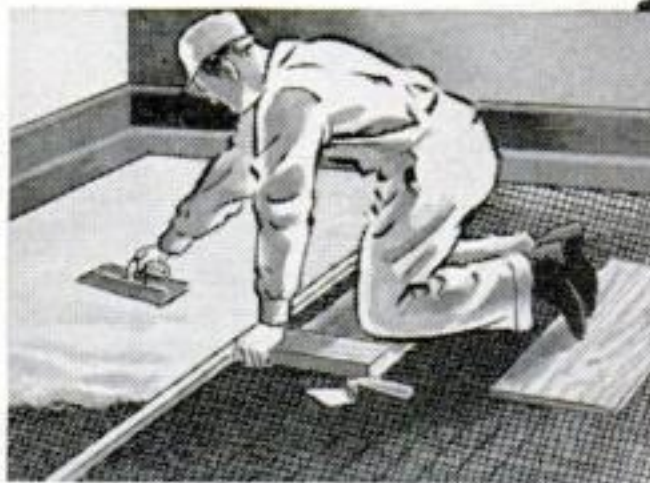
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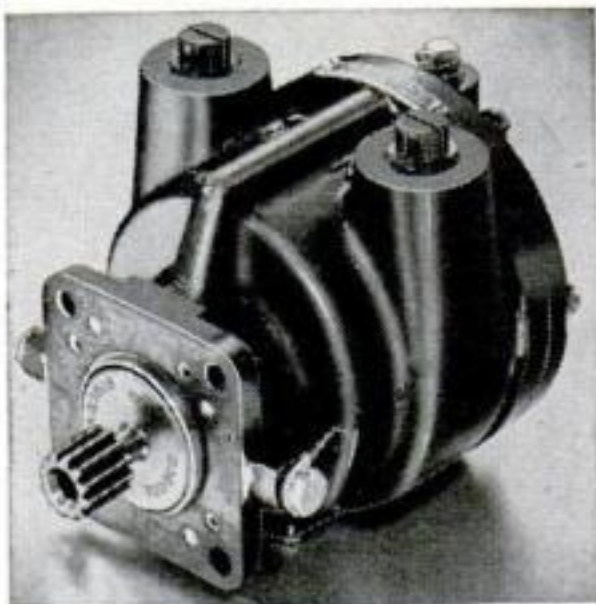
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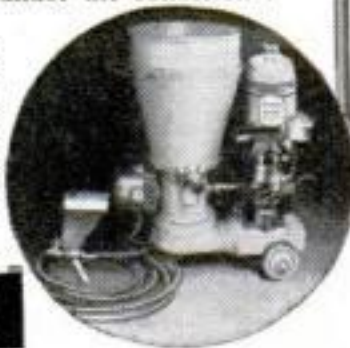
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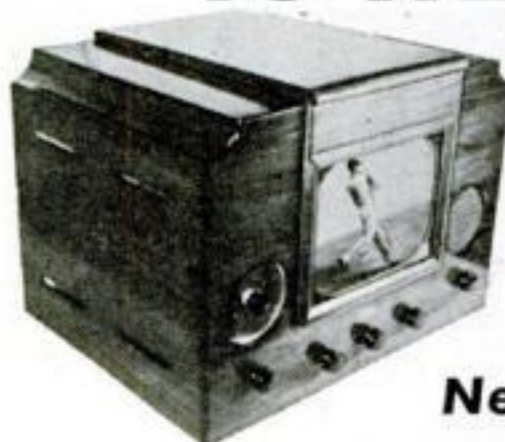
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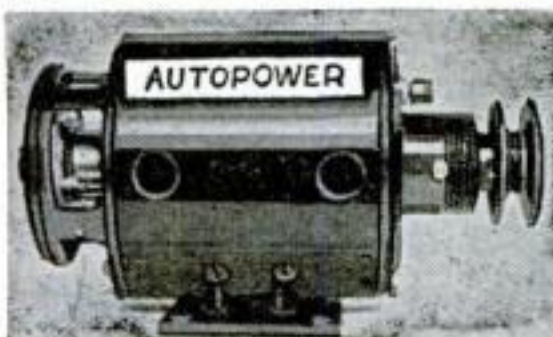
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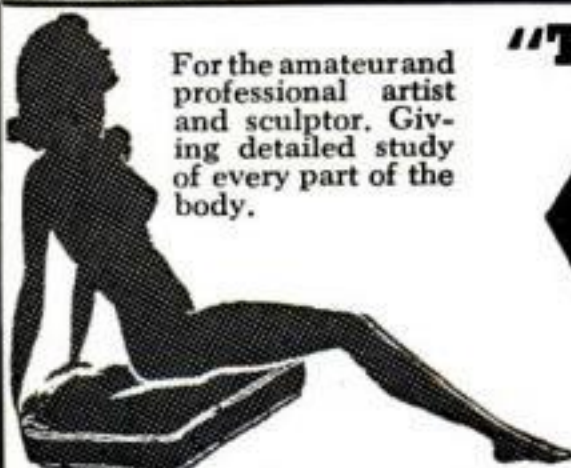
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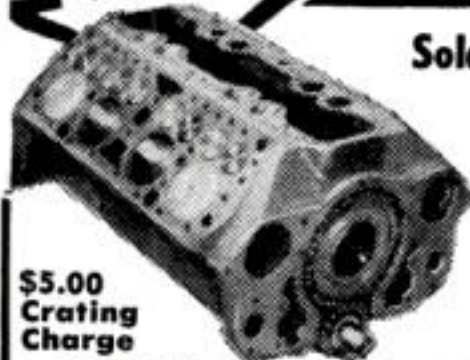
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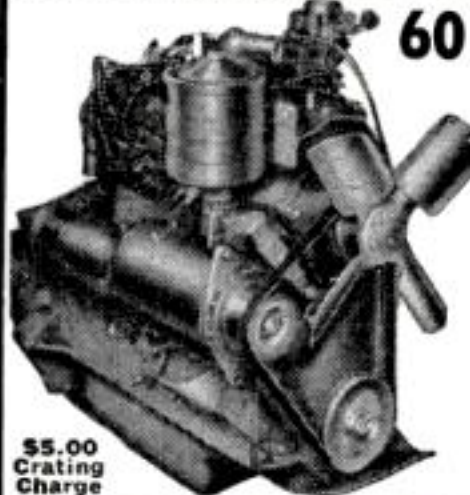


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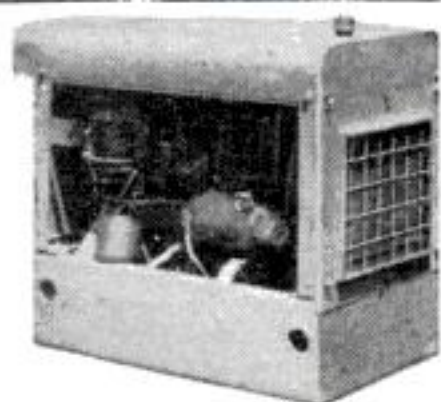
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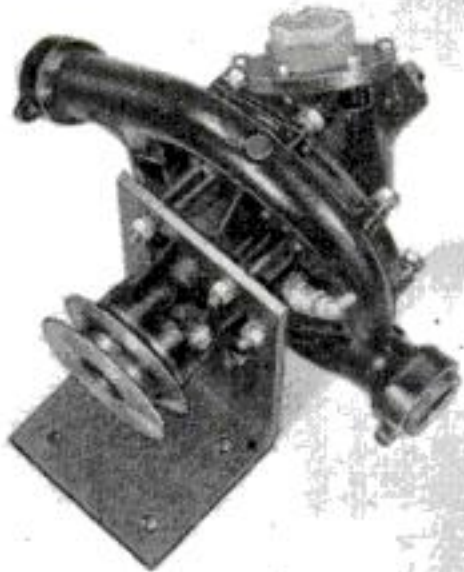
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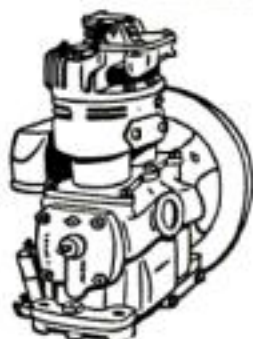
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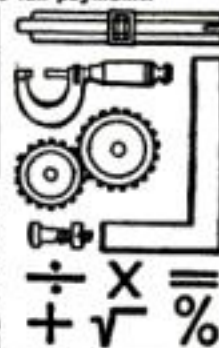
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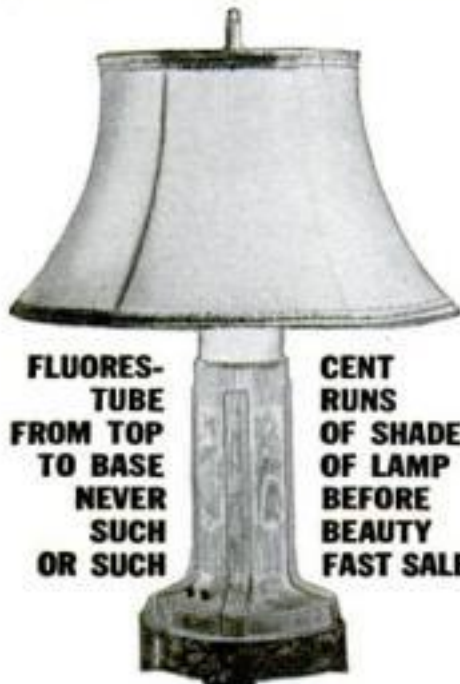
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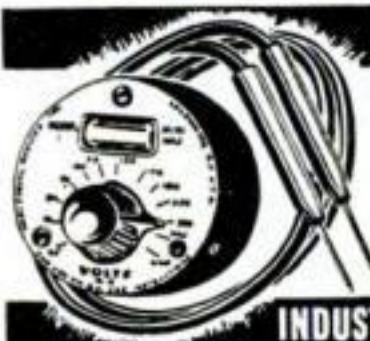


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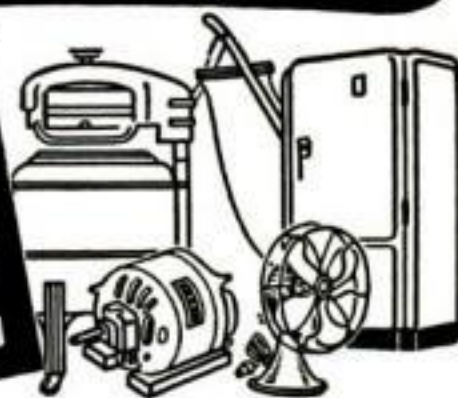
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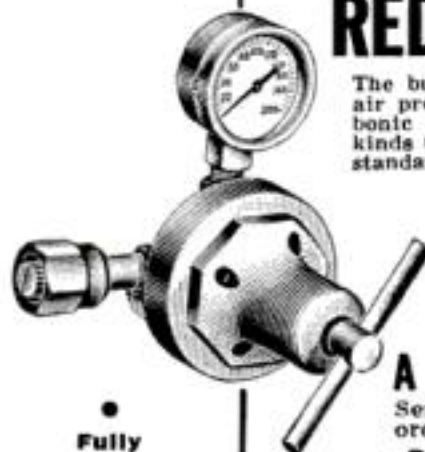
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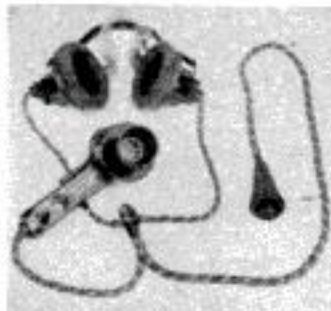
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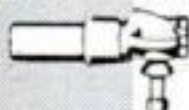
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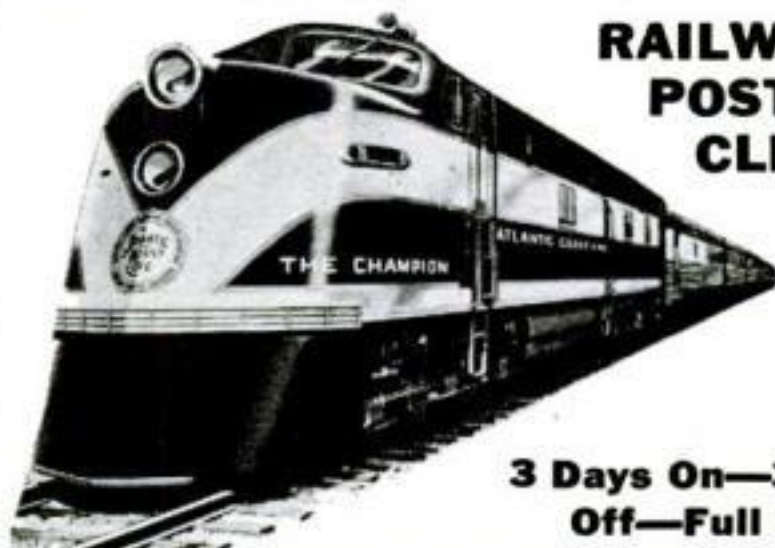
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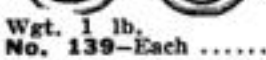
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**INTERNAL Carvings, Drills, Dyes, Jewelry Findings, Tools, Plexiglas, Masked Sheets 12"x12" 1/16"—\$1.00, 1/8"—\$1.25, 3/16"—\$1.55, 1/4"—\$1.85.** Include 10% postage. Rods, Tubes, Dyes, Cements, Buffing Compounds. Free Listings. Craft Plastics, Somerville, New Jersey.

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Martin King is the Henry Ford of the fountain pen industry. For 26 years he has been a pioneer in designing quality fountain pens... and bringing them down to the price that the average man can afford. In this sensational new offer, he has introduced his latest and greatest value. At his present costs, this pen with refill ink cartridge and brand new ball point would have to sell at \$10.00 or more to show a profit! But he has staked everything on the belief that, at this low \$1.98 price, volume sales will bring down his cost—and that this \$1.98 value will be the largest selling unit of its kind at any price! Readers of POPULAR SCIENCE get first call on this great value. For this advertisement is one of the first public announcements in America! And here is Martin King's challenge offer... to prove to you that you should mail the coupon below and be among the first to cash in on this great value:

**SEND NO MONEY** Just Mail Coupon!

**Satisfaction Guaranteed or Your Money  
Refunded PLUS ONE  
DOLLAR FOR YOUR  
TIME AND TROUBLE!**

Yes, Martin King makes this challenging offer. Don't send a penny. Just mail coupon at right. Pay postman only \$1.98 plus C.O.D. postage when package arrives. Then try this pen. Compare it for writing quality in day-by-day use. Then if you're not 100% delighted with the "buy" you've made... just return it. Martin King will not only refund your purchase price in full... **HE WILL PAY YOU ONE DOLLAR EXTRA FOR YOUR TIME AND TROUBLE.** You'll agree that Martin King must have an outstanding value when he makes such a daring offer. So get yours without delay. Mail coupon at right!

**THE PENMAN** Dept. 48-P, 179 N. Michigan Ave.,  
Chicago 1, Ill.

ONLY  
**\$1.98**



**LOOK-**  
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**LOOK-ALL METAL  
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**LOOK! READY-  
TO-USE REFILL  
INK CARTRIDGE  
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REMOVE  
EMPTY  
CARTRIDGE &  
BALL POINT

REFILL  
SNAPS RIGHT  
INTO PLACE

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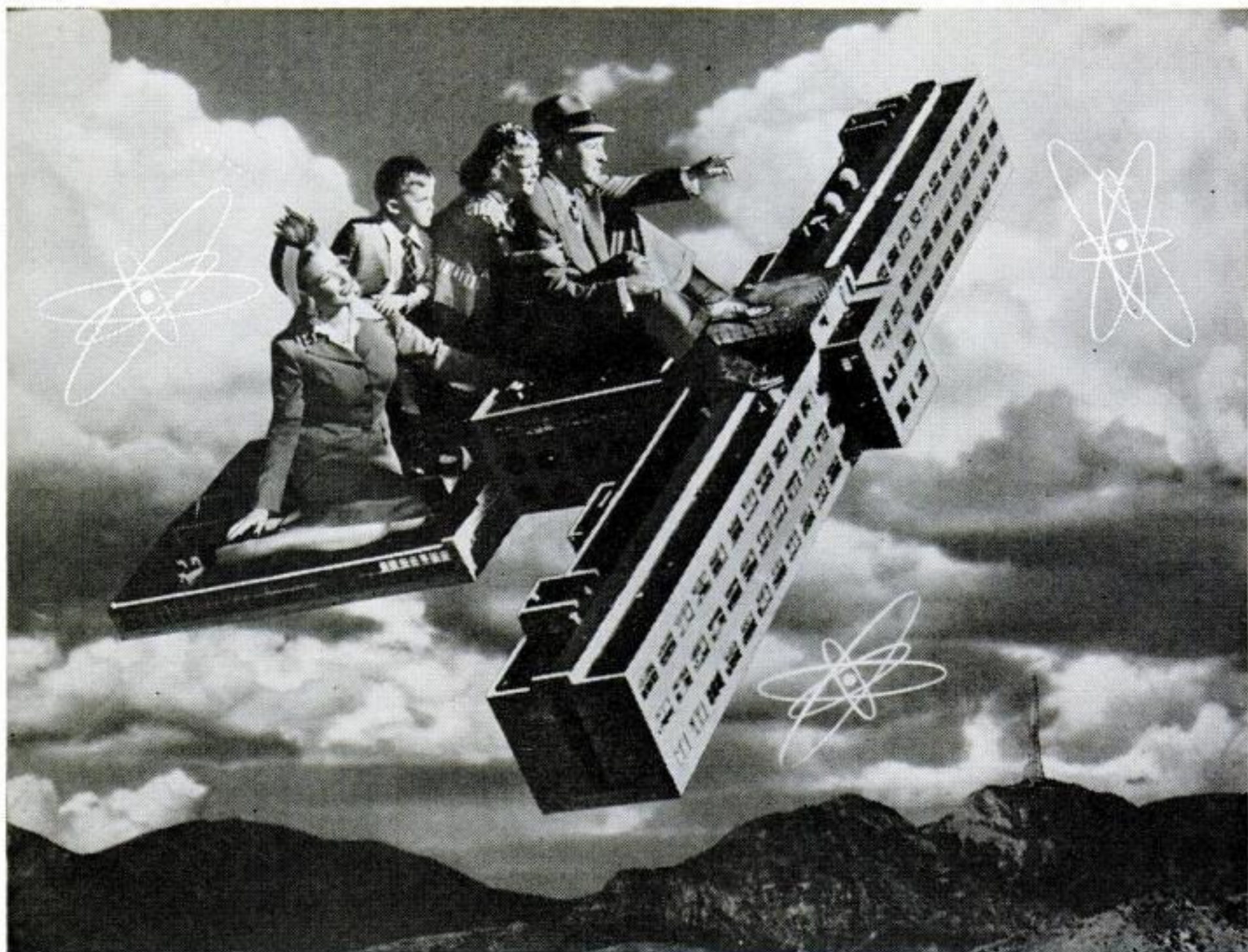
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Street.....

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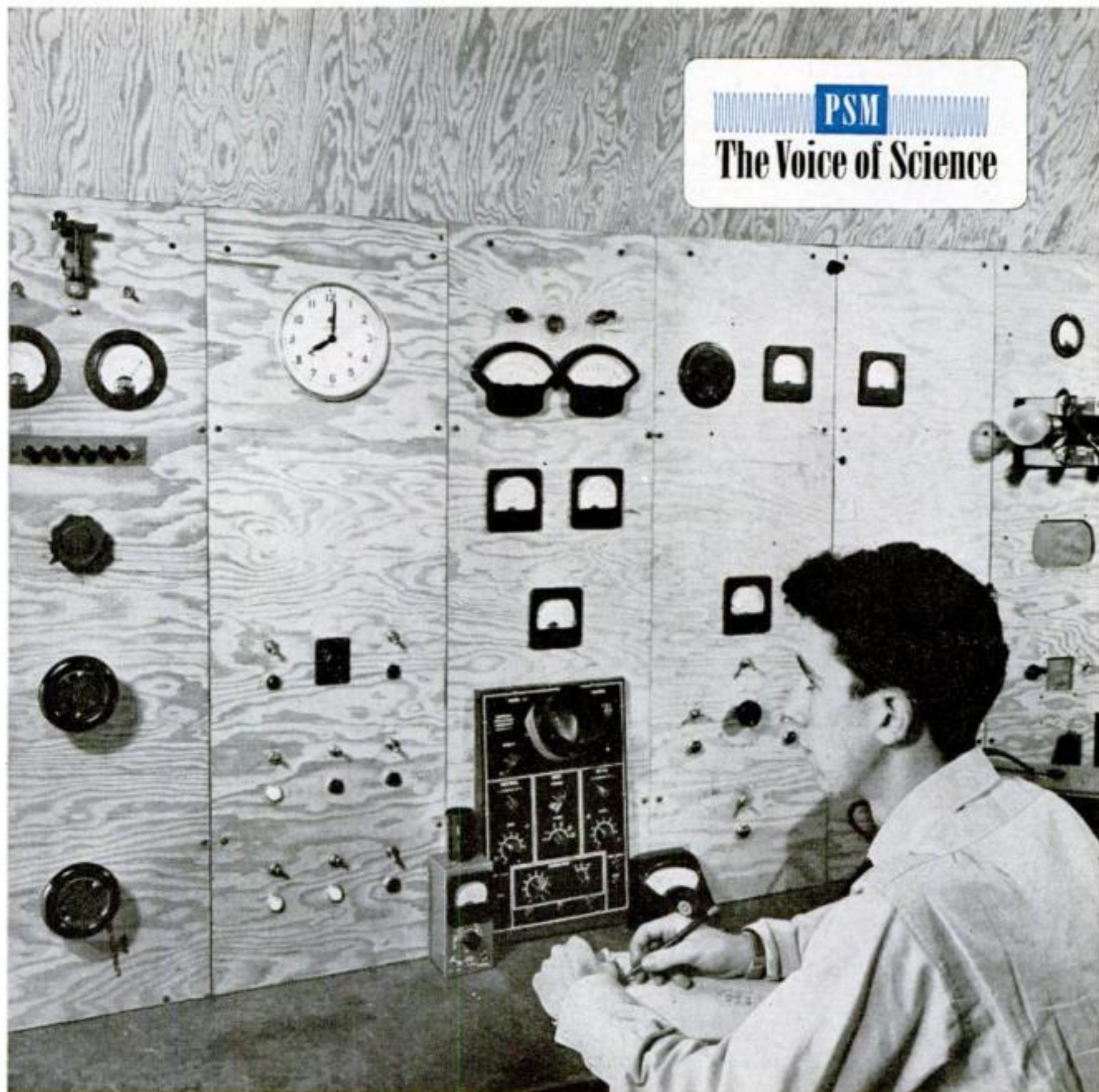


RCA Laboratories at Princeton, N.J., one of the world's centers of radio and electronic research. • When in New York City, see the radio-electronic wonders on display at RCA Exhibition Hall, 36 West 49th Street. Free admission. Radio Corporation of America, Radio City, New York 20.



**RADIO CORPORATION of AMERICA**





## Atomics for Schoolboys

**M**EET Richard Sinnott, age 18. He is a student at the El Cerrito High School in California. He is sitting at the unglamorous plywood control board of one of the most exciting machines ever devised by man.

It is a baby cyclotron, put together by four El Cerrito students under the inspired leadership of their physics instructor, Ben Siegel (see p. 102). To dare such a project—a little like building a blast furnace in the back yard—called for considerable courage. To complete it, within limited space and funds, called for a lot of plain hard work.

Oak Ridge or Caltech hardly need fear the competition of this home-made atom-smacker. But, small as it is, the El Cerrito

cyclotron has made a big contribution. It has brought nuclear physics—once the private preserve of heavy thinking and heavy equipment—closer to home.

To these lucky students, as they put the pieces together, theory became practice. And as they wound the wire to make the magnet and saw the machine take shape, they got an awareness and a sense of personal participation in the biggest problem in the world.

Whatever its actual output of radioactive materials, its production as a tool of understanding is important.

*Perry Githens*



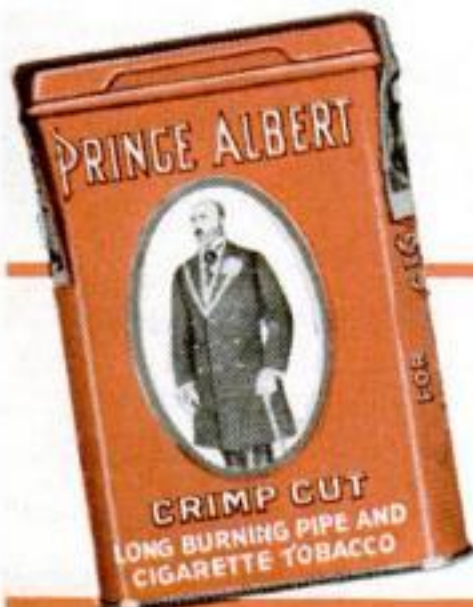
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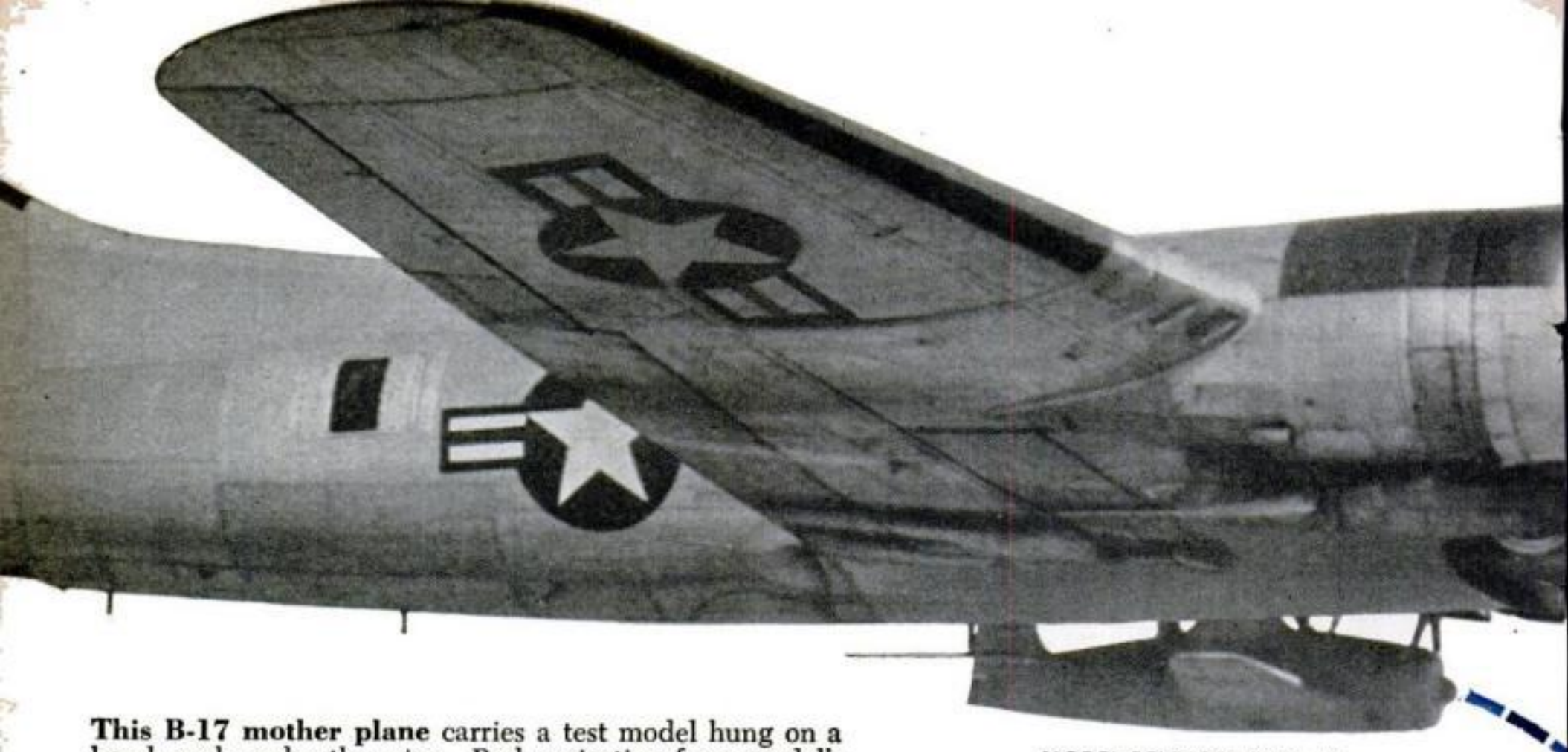




## ***Tough, Dangerous, and Dirty ...***

Working high up in a regenerating unit is but one of the many nasty and hazardous jobs involved in the annual cleaning of a cat-cracker. These catalytic oil-processing units, operating 24 hours a day at temperatures around 1,000° F, take a terrific beating from erosion and corrosion. The "turnaround"—the cleaning process—involves shutting down the plant. A crew of 360 men did the job on this M. W. Kellogg unit at Gulf's Philadelphia refinery without an accident.





This B-17 mother plane carries a test model hung on a bomb rack under the wing. Rod projecting from model's tail is the antenna for the telemetering equipment.

MODEL RELEASED BY B-17  
IN LEVEL FLIGHT

## ***Robot Planes Dive Into Speed's Mysteries***

Without pilots or engines, the Navy's 600-mile-an-hour midgets report from the edge of the sonic barrier.

**By George H. Waltz, Jr.**

A B-17 drones steadily across the sky. Suddenly, from under its wing, a tiny plane drops into a steep dive. No propeller spins, no jet roars, but it screams down at 600 m.p.h. No pilot sits at the controls, but the midget pulls out of the dive and swings upward in a long curve. For a second it seems to hang in the air. The nose blows off and hurtles down. Then a great plume of parachute appears over the plane and it drifts slowly to the water below.

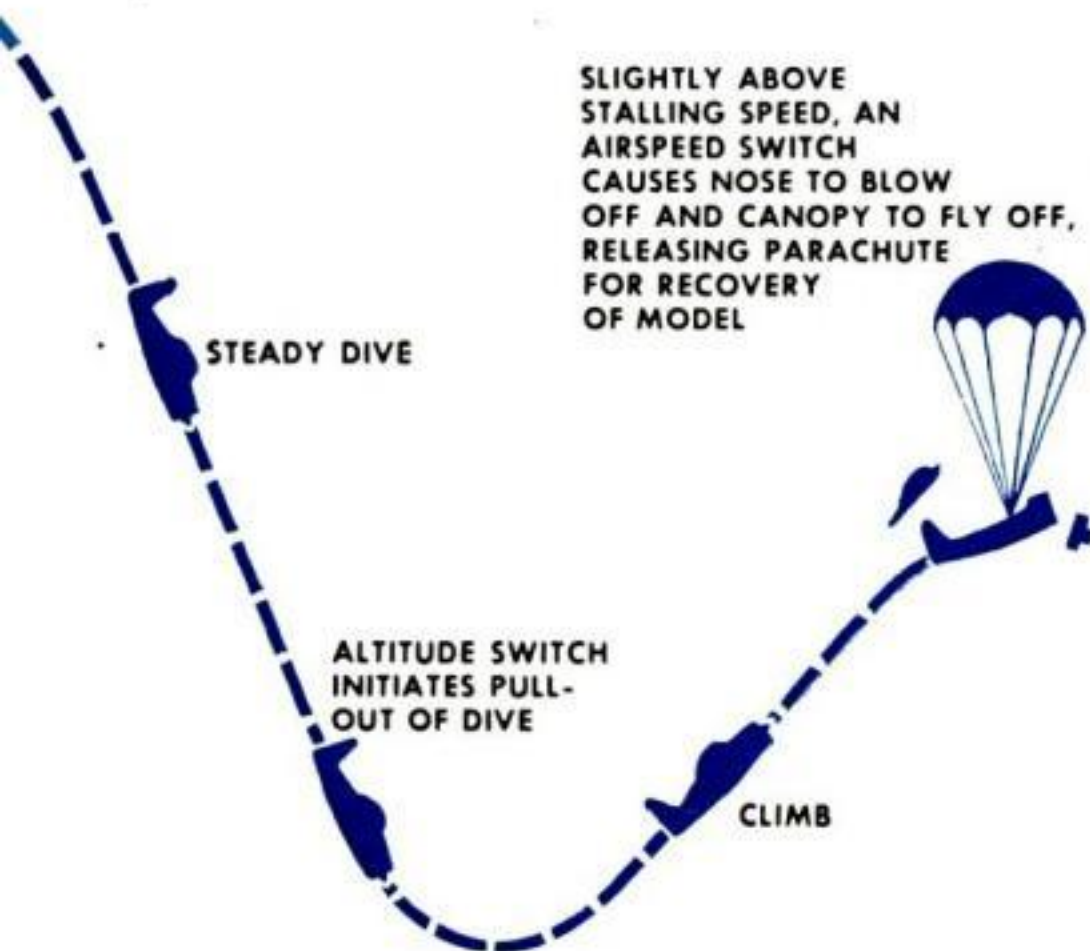
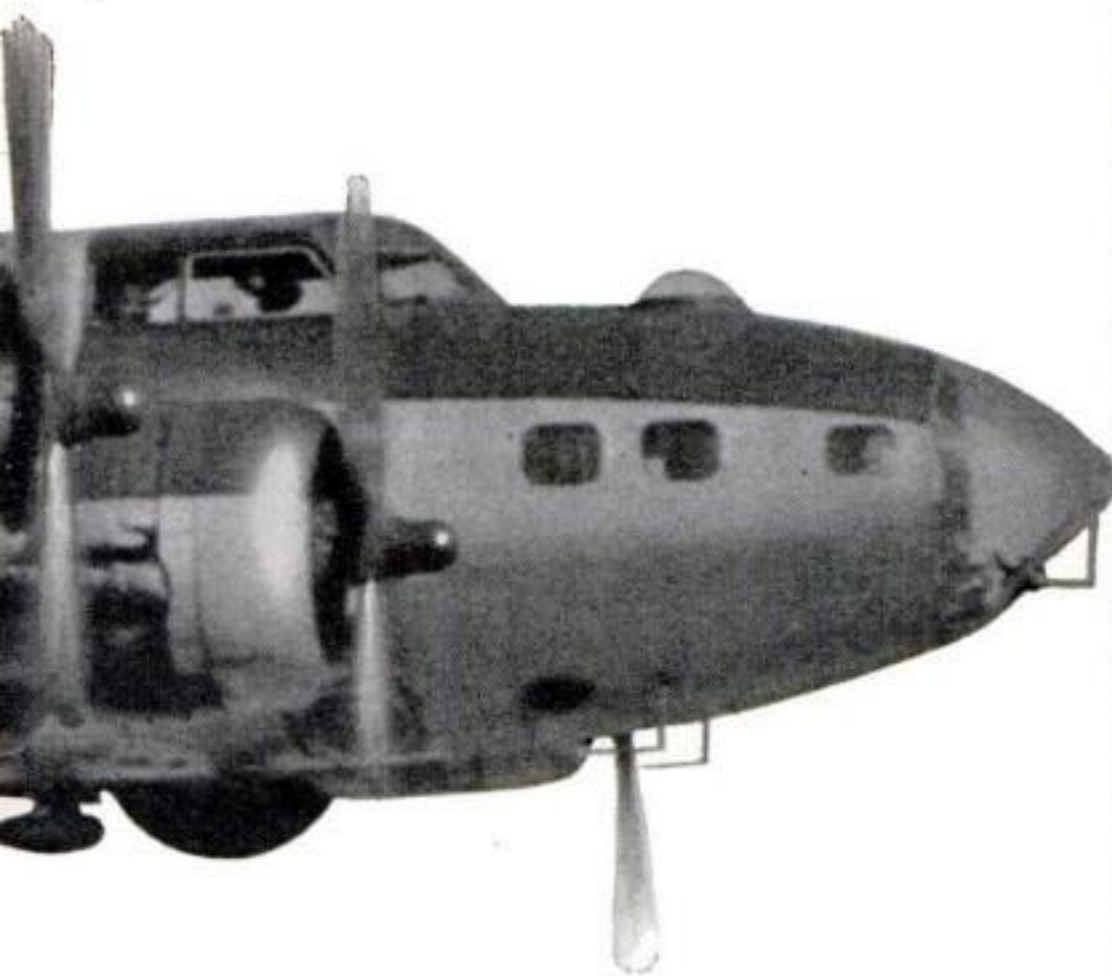
That's the Navy's latest approach to the problem of designing transonic and supersonic aircraft. The diving midget is an exact scale model of a proposed superspeed plane. Dropped at the Navy's target range near Wallops Island, off Chincoteague, Va., it is put through its paces by preset controls while a radio telemeter reports what happens. Experts of the Naval Air Experimental Station at Philadelphia believe that this model-dropping gives actual flight data

unobtainable from wind tunnel tests. And it does it without risking the life of a pilot or the loss of a full-size plane.

The 1,500-lb. models are built of wood to stand a pull-out force of 30 Gs (30 times the pull of gravity). Aerodynamically they are the same as a full-size plane of the design under test, but they are only four-tenths as large and a 450-lb. lead nacelle replaces the engine. Right behind the nose is the six-channel radio telemetering system. Behind that again, about where the cockpit would be in a regular plane, is the automatic gyro flight-control gear.

The model is hung in a modified bomb rack under the left wing of the mother plane, to the right of the inboard engine. About 10 minutes before drop time the gyro control and telemetering systems are turned on. The pilot puts the mother plane through simple maneuvers to make sure that the model's control surfaces are reacting properly and the telemeter is working. The model's ailerons, rudder and elevators should move in opposition to those of the mother plane, since the control gyros try to keep the model's wings level and its nose on a straight course. These movements show up in the mother plane's telemeter receiver.





Just before the drop, the pilot feathers the propeller on the mother plane's No. 2 engine to eliminate any backwash or turbulence that might interfere with the release. Then, at "D" time, with the mother plane flying straight and level, the pilot pushes the bomb release and the model drops.

Immediately four sets of ground observers go into action. Two crews man identical telemetering receiving stations mounted on trucks, checking each other and ready if one receiver should fail. A third crew tracks the model by radar to plot its flight path. The fourth checks the path visually with a theodolite. Among them they record the complete story of the drop.

The telemetering equipment can be set to



**Actual drop test** over range provided this photo sequence showing model just before release, just after release, about to dive, and afloat after parachuting down. B-17's No. 2 propeller is feathered to cut turbulence for model.



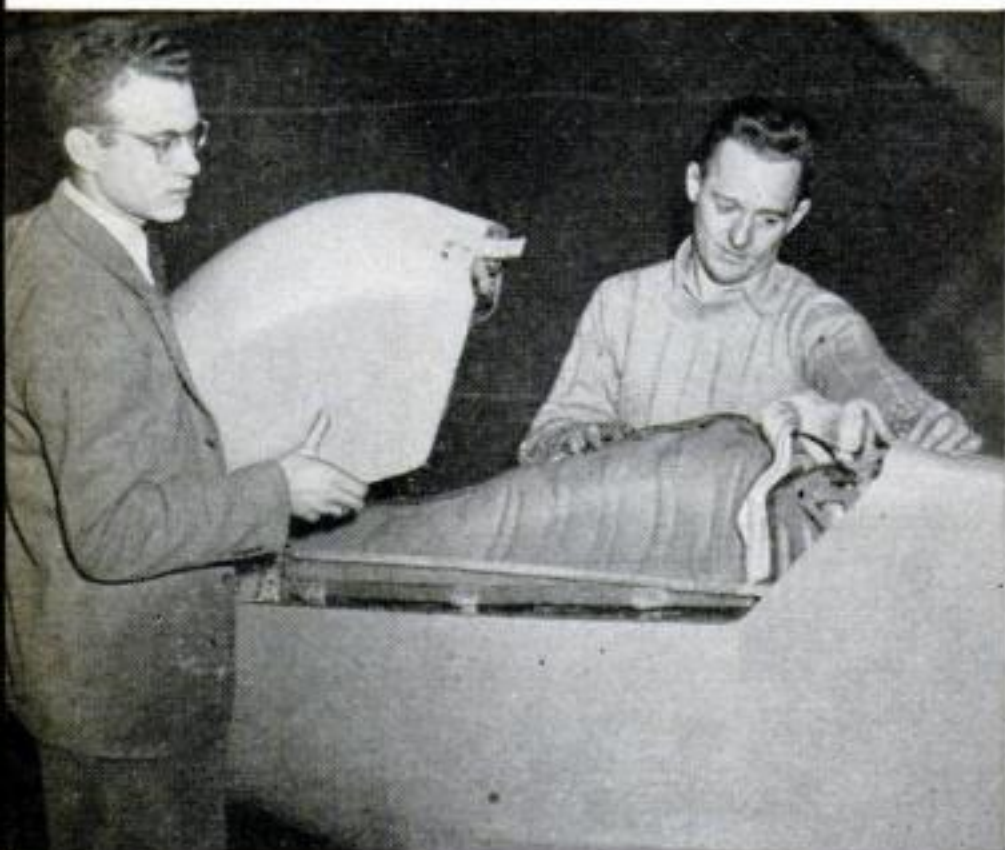


**Telemetering equipment**, which gives more elaborate reports than any human pilot could,

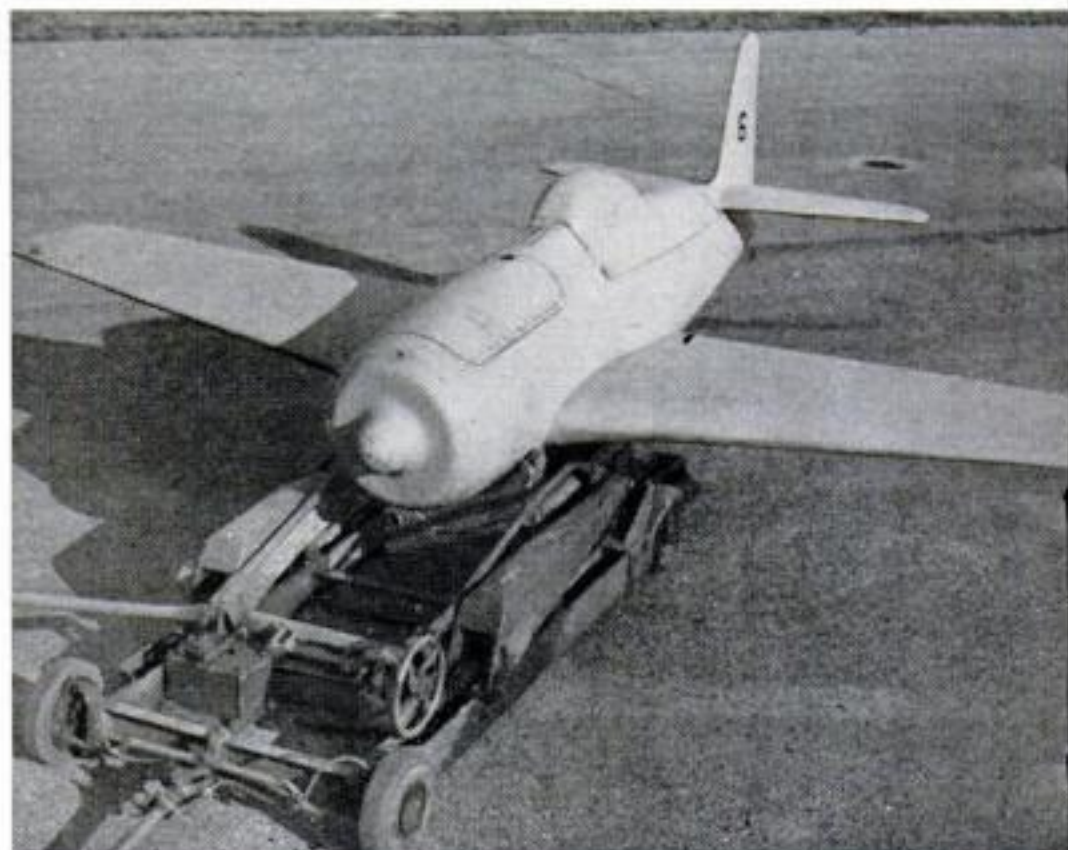
is carefully tested before a flight. The cover of this compartment is also waterproof.

flash back any combination of six continuous records of pertinent flight data. These can include the readings of stress and strain gauges at important points on the model; airspeed, acceleration and G forces; position of rudder, ailerons and elevators; buffeting of controls; dive angle and angle of roll—just about everything the engineers might want to know. When plotted in simple graph form, these readings tell just what happened to the model during its flight.

Normally the gyro controls are preset to put the model into a  $30^\circ$  or  $60^\circ$  dive as soon as it is released, pull it out after it reaches terminal velocity, put it into a  $40^\circ$  climb, blow the nosepiece free to reduce the strain on the 'chute, and then pop the 'chute open. The controls can, however, be altered to put the model through various maneuvers and dives. Both the controls and the telemetering equipment are completely automatic once they have been started by

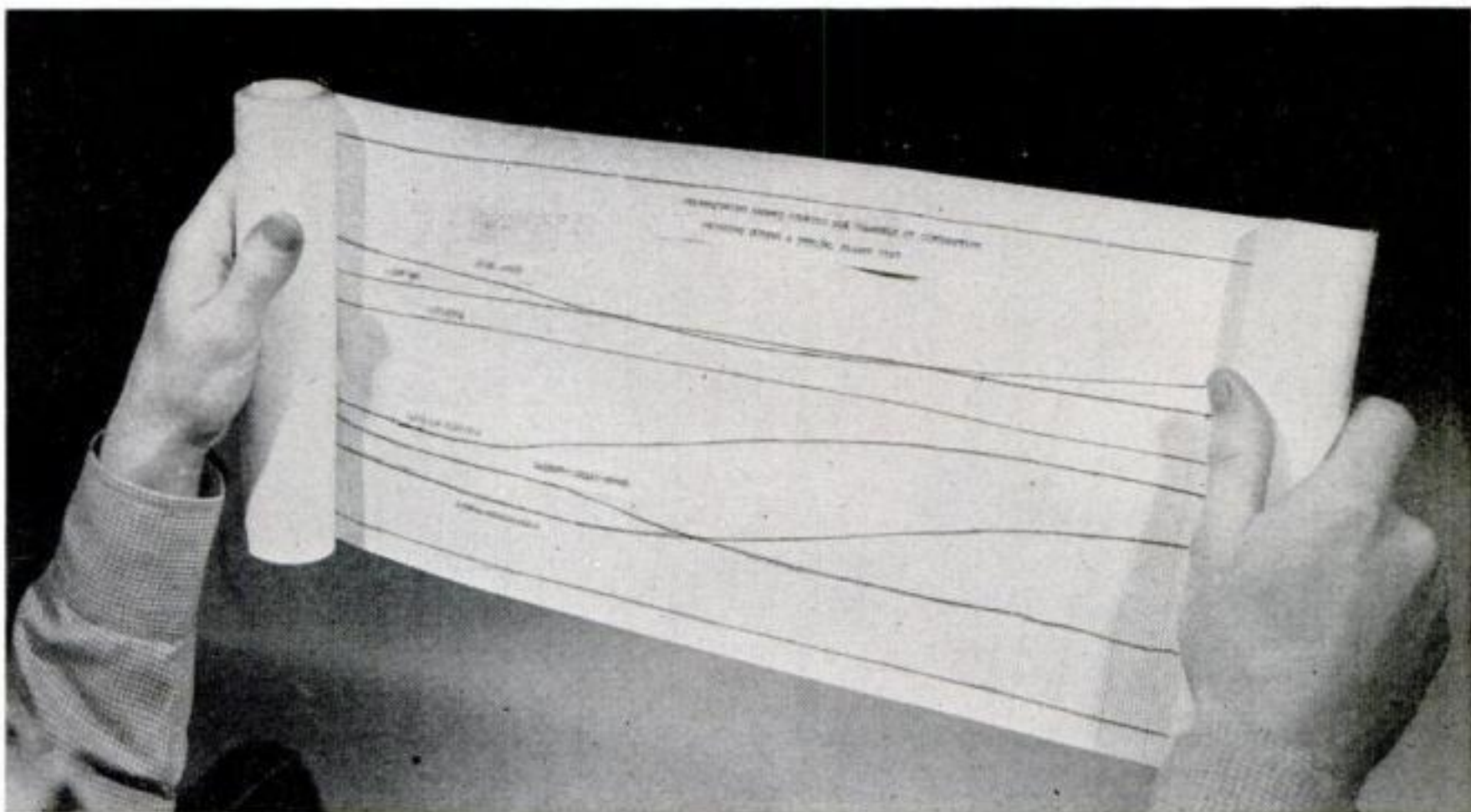


**The recovery parachute** is packed into place after the flight-control compartment has been sealed shut with a watertight cover. Gyro controls within are driven by compressed nitrogen.



**The streamlined canopy** has now been securely fastened, and the model plane is ready to be rolled out to the mother ship and fitted into the bomb rack under the left wing.





**Wavy lines** of this graph plotted from telemetered data tell engineers just how model re-

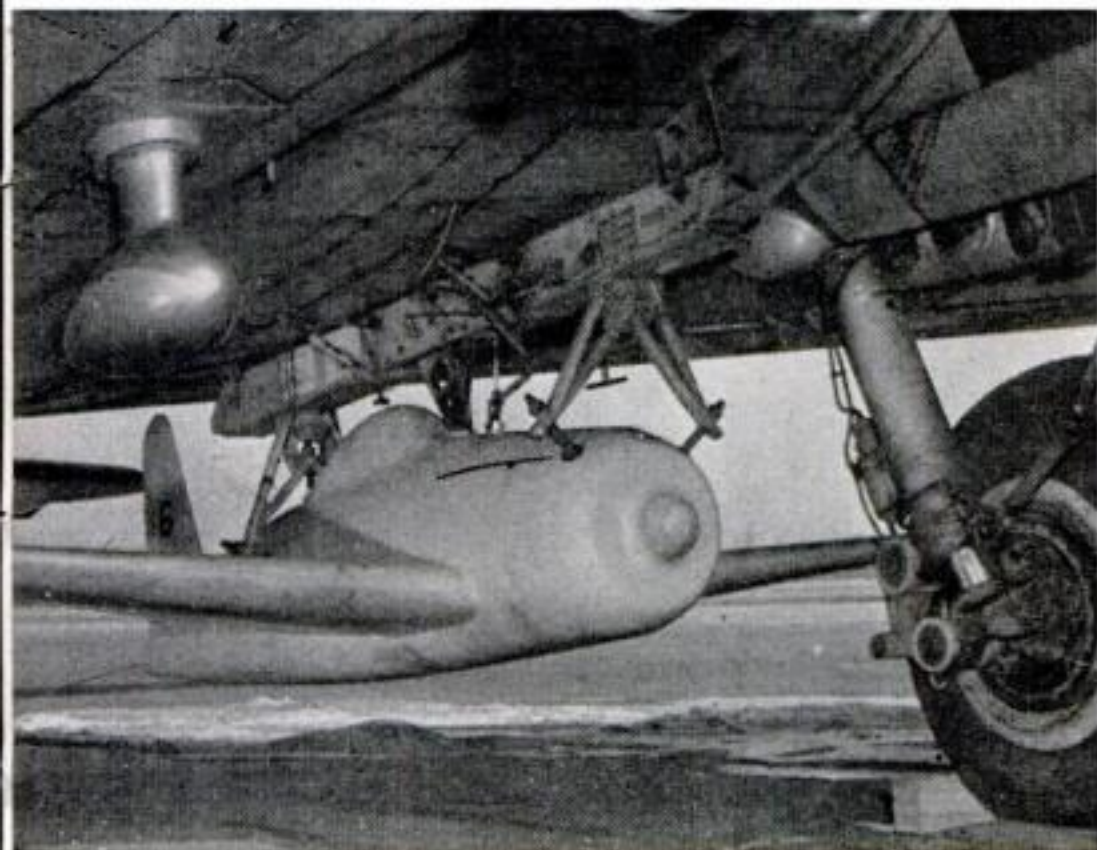
acted during its dive. With powered models, graphs may answer riddles of supersonic flight.

master switches in the mother plane. An electrical cable connecting the equipment in the model to the mother plane pulls free when the model drops away.

So far, all the models are without power—but when one is dropped at 35,000 feet it hits a terminal speed of 600 m.p.h. at 20,000 feet (roughly eight-tenths of the speed of sound at that level) just from the pull of gravity alone. Eventually jet or rocket engines may be added to blast the

models through the transonic zone. Then the telemeter operators on the ground will record a vivid picture of what happens when an airplane reaches supersonic speed.

If this happens, engineers will gather their data on buffeting and the shock waves of compressibility long before a pilot touches the controls of a transonic plane. Indeed, before a full-size plane is built its design will have already been modified and perfected—thanks to the diving models. **END**

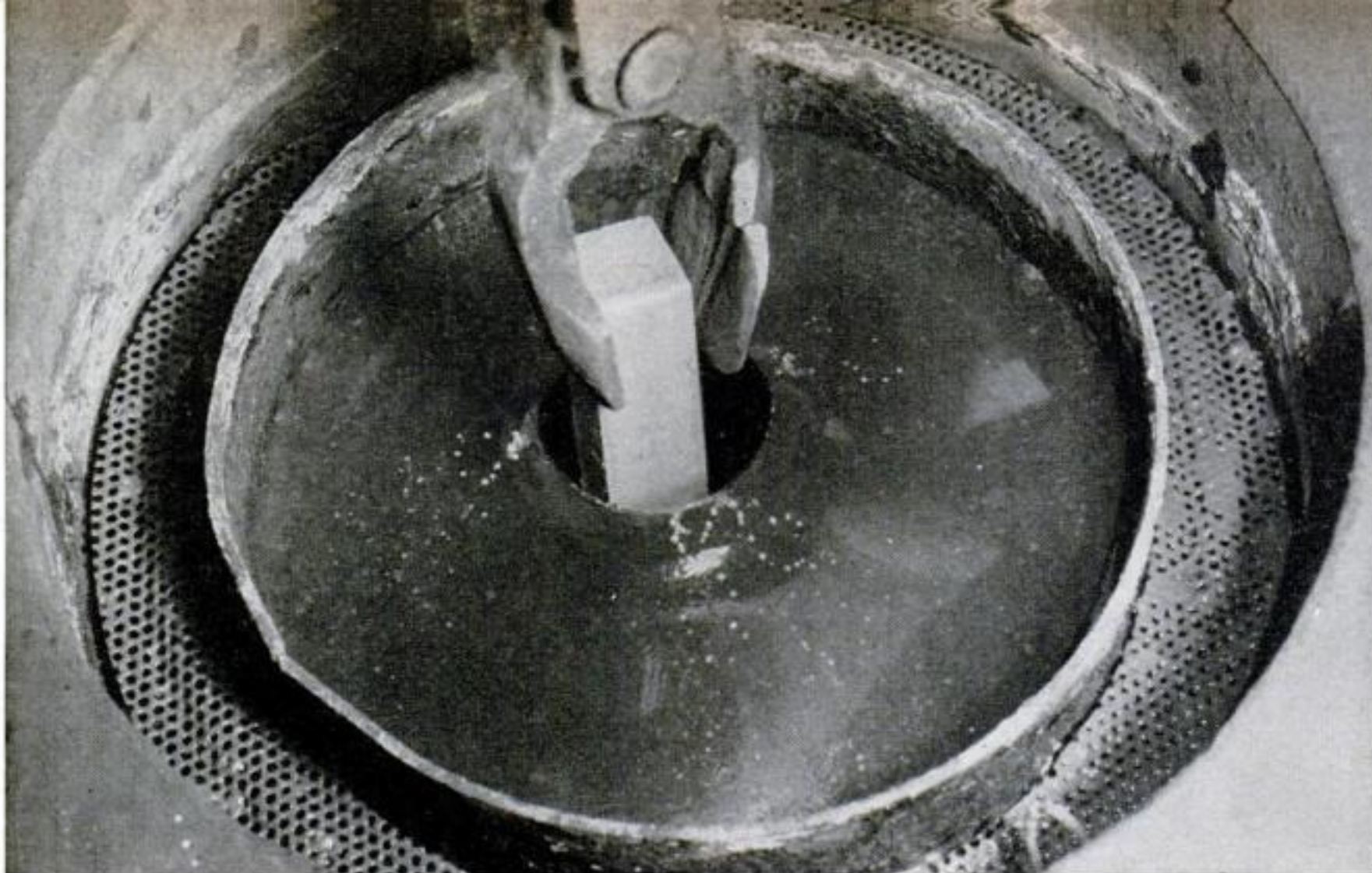


**The model is fitted into place** just to the right of No. 2 engine. B-17s were chosen for mother ships as the only large military planes whose landing gear does not interfere with models.



**This large radar scanner** tracks the model on its way down. The dive is also followed visually by a theodolite, giving a two-way check on reports sent by the telemetering equipment.

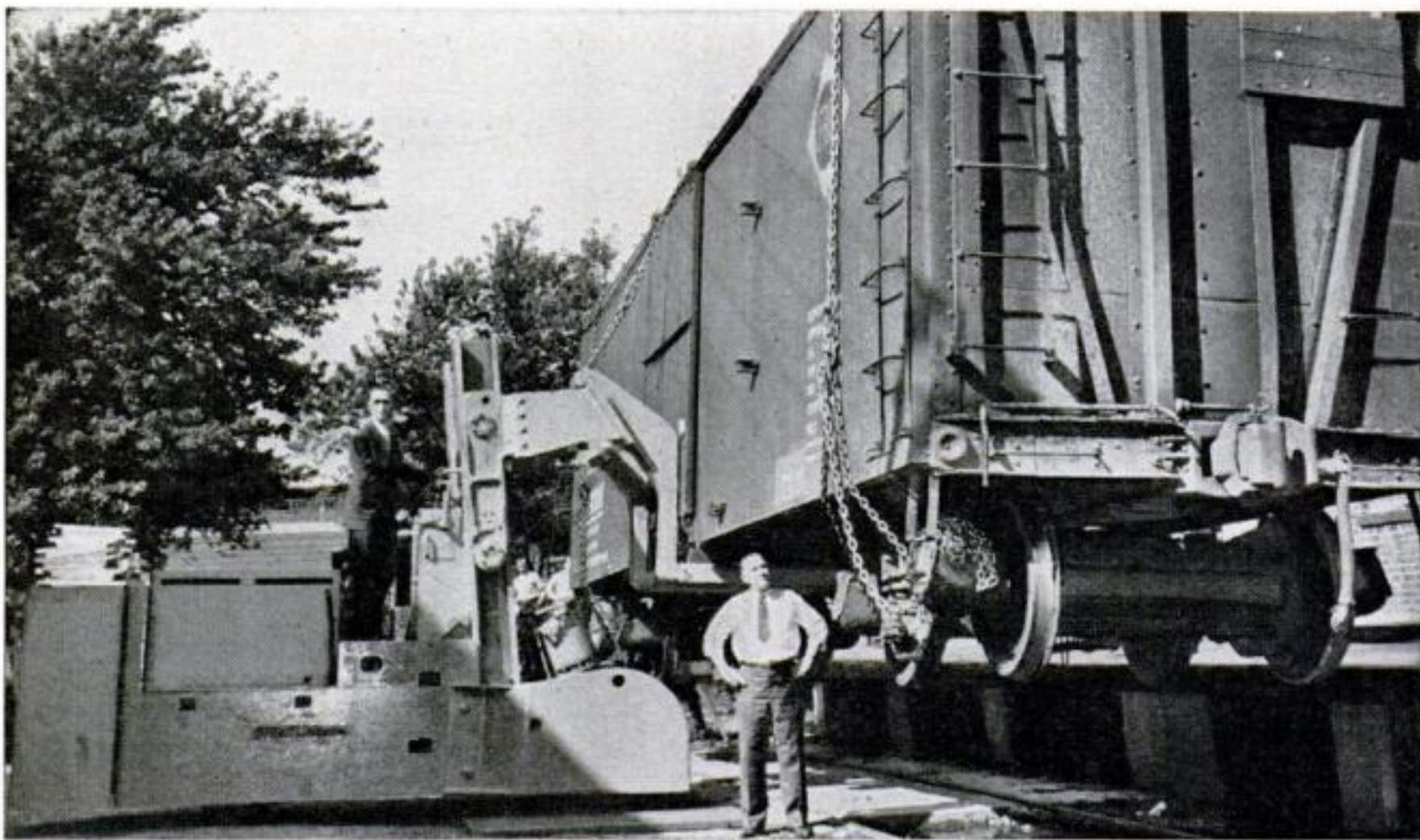




## Punches Holes in Water

PUTTING a hole in a liquid is tough enough, but the U. S. Steel Corp. Research Laboratory in Kearny, N. J., goes one better and punches the round hole above with a square peg. It's part of a quenching operation to increase the wear resistance and hardness of

steel. A white-hot steel bar is thrust into water, superheating the surrounding water to an invisible vapor. The steam, obeying the laws of gases, expands and forces the liquid away from the bar—and a round hole results because gases exert equal pressure in all directions. A 1/10,000-second stroboscopic exposure caught the "hole."

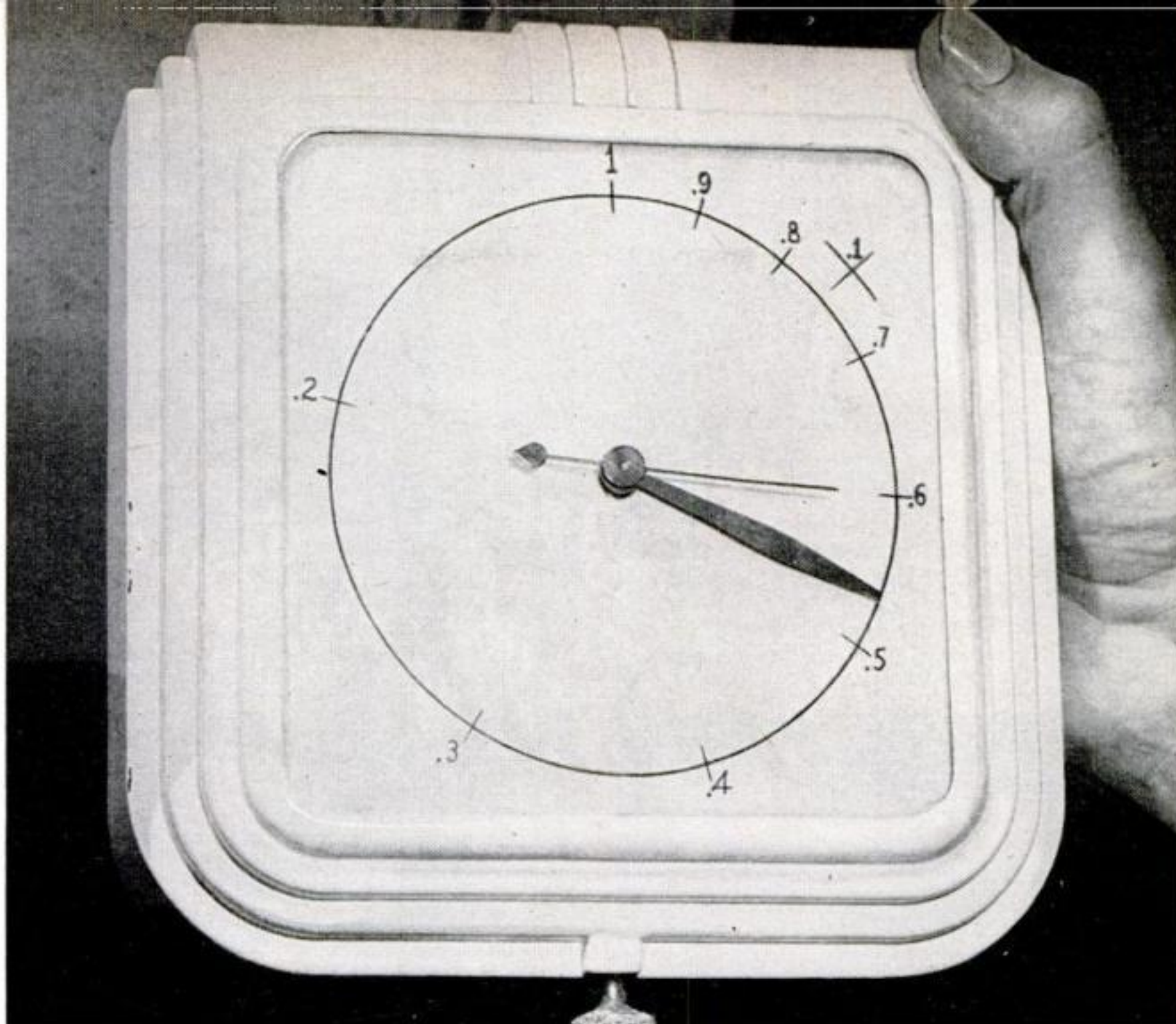


## Potent Push-Up

THERE'S a new electric strongman in the steel mills—the fork and ram truck designed

by B. I. Ulinski to lift and move heavy rails. In this demonstration, the automatic lift truck hoists a 45,000-lb. boxcar. It can handle loads from 10 to 30 tons.





**Clock Explains "Half Life."** Like radium, man-made radioisotopes emit rays and "decay" or turn into other elements. Half life, the measure of their perishability, is the time it takes half of the atoms to do this. The "decay clock" above makes the idea vividly clear.

This is an ordinary electric clock minus its hour hand. Its special dial tells the life story of a short-lived radioisotope, Carbon 11. Set to 1 at top of dial, the minute hand is started

when the isotope is first made. Clock shows what fraction of the original amount of Carbon 11 remains, as hand passes figures from .9 down to .1, which it reaches in a little more than an hour on its second time around.

In the picture, the minute hand is approaching .5, which marks the half life of Carbon 11 (20½ minutes). Increasing intervals show why half life serves as yardstick. Complete decay would take an infinitely long time.

# Mail-Order Isotopes

**Mass production of man-made "radium" provides a wonder tool to aid international research.**

**By Alden P. Armagnac**

*PSM photos by Hubert Luckett, Robert F. Smith*

**A** NEW era in medicine and technology began last September 5 when a lead-lined box containing radioactive phosphorus started by plane for Melbourne, Australia.

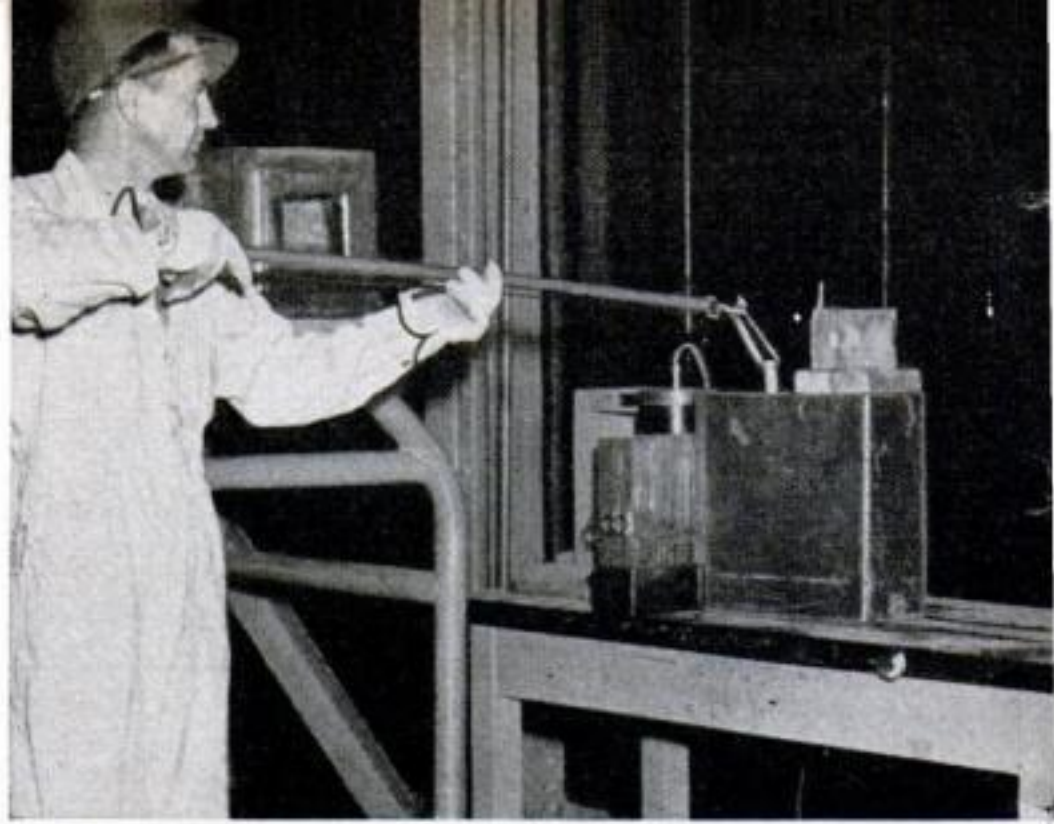
Urgently needed to treat a patient with a blood disorder, it inaugurated world-wide distribution of man-made radioisotopes—"artificial radium" in layman's language—from the chain-reacting uranium pile at Oak Ridge, Tennessee.

Treating disease with rays from radioactive isotopes—radioisotopes for short—has unique advantages. Injected in a vein or tissue, or simply swallowed by a patient in a tasteless solution, the radiumlike material

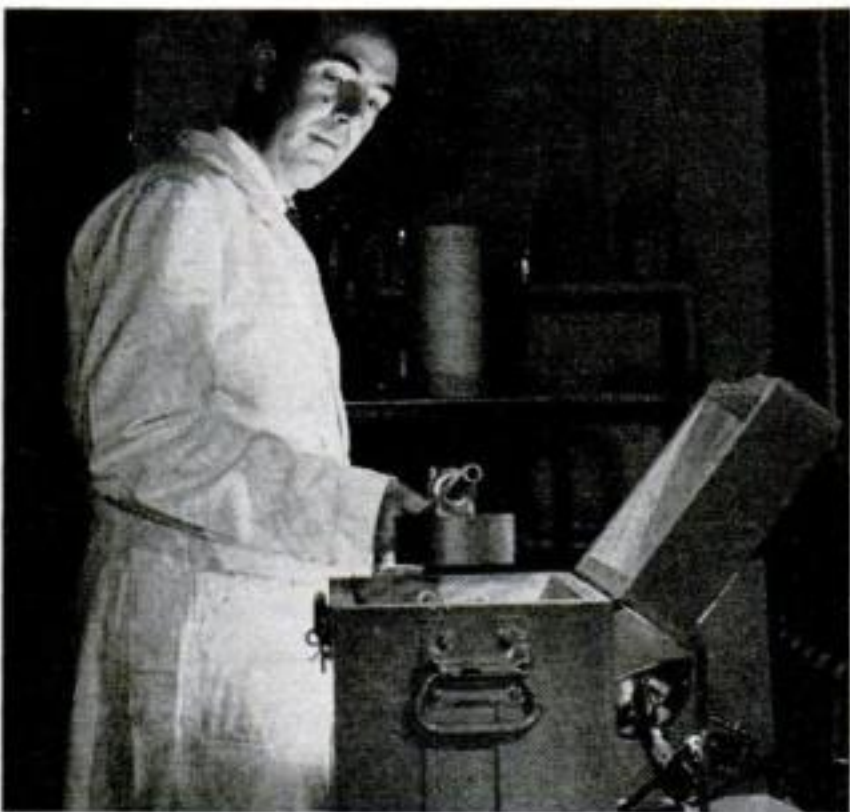




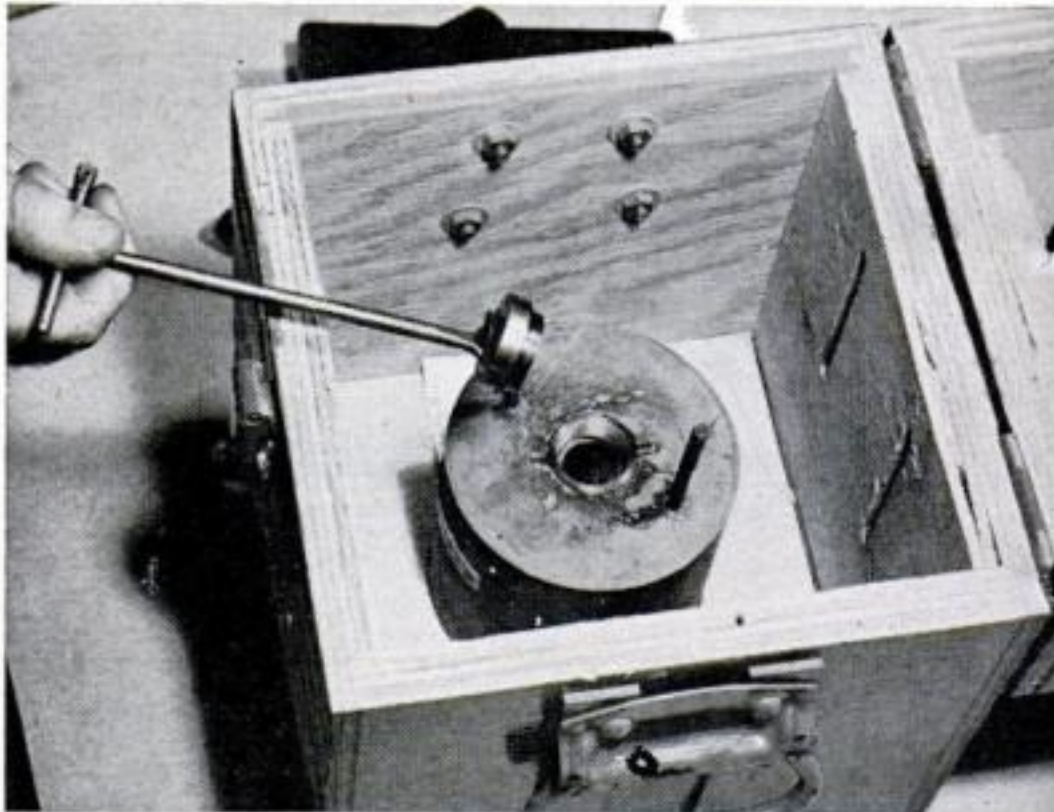
**1. Dr. Ernest Pollard**, of Yale physics department, fills out order blank for radioisotopes. Mail-order catalog in his hand lists radioisotopes available from Oak Ridge with prices.



**2. At Oak Ridge**, radioisotope taken from pile (through aperture above man's arm) has strength of rays tested before shipment. It must be handled at safe distance with aid of long tongs.



**5. Treating the package** with caution, despite moderate ray strength, Dr. Pollard lifts out top of lead container by inserting rod in eyebolt. Geiger counter is now clicking at rapid rate.



**6. Special key** supplied with package fits slot in screw top of inner, stainless-steel container so it can be unfastened and removed, as shown, without need of touching it with hands.

goes straight to the affected spot. After delivering just the proper dosage of rays, it automatically "turns them off" as its short-lived radioactivity dies away.

In another application, radioisotopes are hailed as the greatest research tool since the invention of the microscope. By definition, isotopes are varieties of a chemical element that differ in weight but possess identical chemical properties. Hence radioactive isotopes may be used as "tracers." Add the corresponding one to a natural element, and you can follow a food or drug through the body, or a chemical through an industrial process, by the telltale rays it emits.

Until a little more than a year ago, radioisotopes were scarce and costly. Cyclotrons

produced them in minute amounts. Fifty dollars' worth of radioactive carbon from Oak Ridge would cost \$1,000,000 if made in a cyclotron.

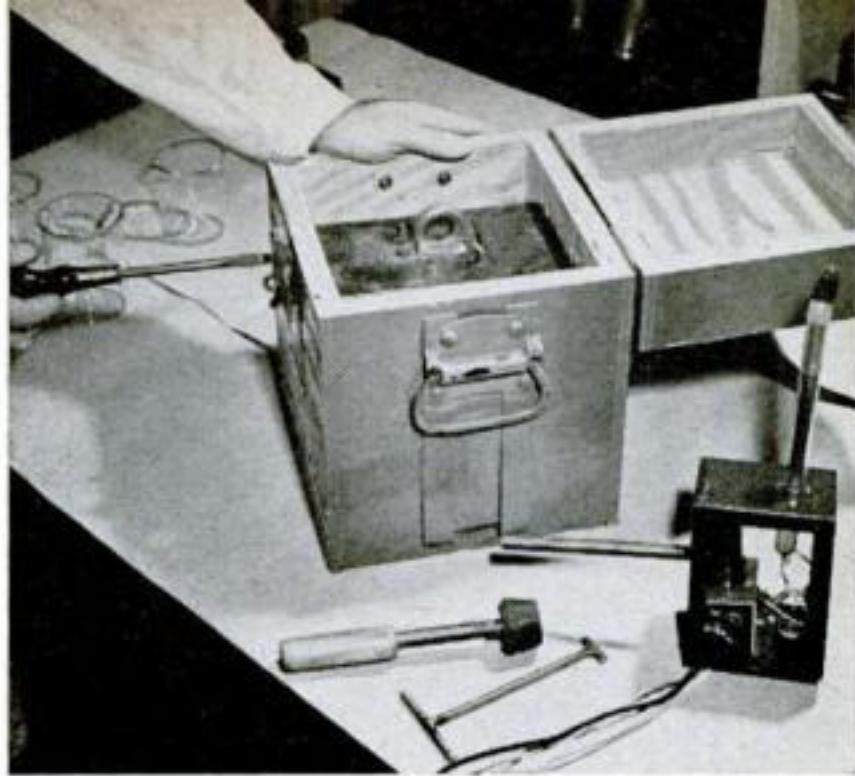
Oak Ridge attains mass production by placing aluminum canfuls of ordinary elements in the pile and bombarding them with neutrons from the atom-bomb ingredient, uranium. Its latest blue-covered, mail-order catalog lists bargain prices for more than 90 ray-emitting isotopes of nearly 60 elements. Domestic users consumed all its first year's output. Now increased production makes the 30 most useful radioisotopes available for export.

A visit to Yale University—first in America, 100 years ago, to offer classes and con-





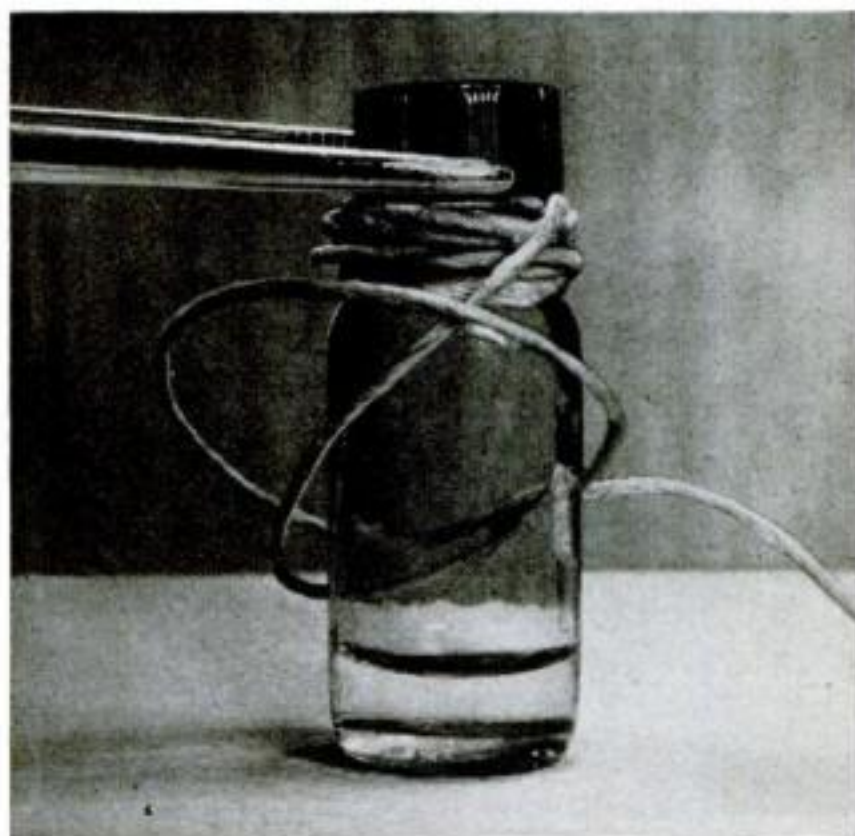
**3. Lead-lined package** arrives by air at New Haven, to be transferred to waiting truck and rushed to University. Most perishable radioisotope shipped has half life of 12.4 hours.



**4. Removing screws** of crashproof metal assembly is first step in opening package. Geiger counter, right foreground, checks how "hot" it is. This is mild one, can be handled close by.



**7. Lead shield** of long forceps protects hand from rays, as glass vial containing radioisotope is lifted from inside of package. This is radioactive iodine, in form of a solution.



**8. Tiny vial**, for which typical package weighs 100 pounds, contains about 35 drops of solution of radioiodine. It comes with string attached for carrying it at safe distance from hand.

duct research in science—gives a firsthand glimpse of radioisotopes in action and the teamwork of the men who are using them.

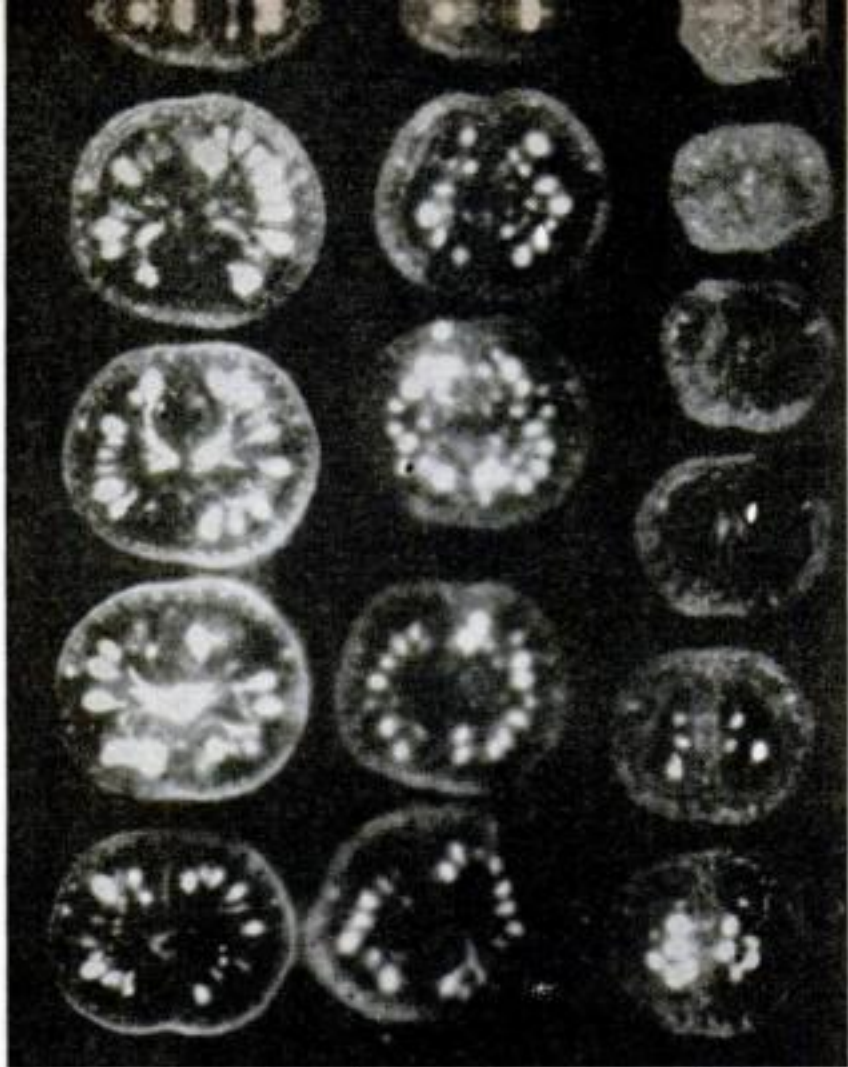
To get the isotopes to users while they're "hot," planes and express trucks rush shipments to Yale's physics department, which handles them for other university departments. Dr. Ernest Pollard, pioneer nuclear physicist, opens them with precautions that vividly bespeak the hazards of the atomic age. Clicking like a telegraph sounder, a Geiger counter gauges the strength of invisible rays from the package, so he will know how gingerly to approach it.

Phosphorus occurs so widely in nature, as in phosphates, that radiophosphorus figures prominently in Yale experiments. To

obtain a successful vaccine against the bacillus of dysentery, Dr. Henry P. Treffers seeks to learn how its deadly toxin kills. By raising the germs in a nutrient medium containing radiophosphorus, he "tags" the toxin with it. Filtering off the toxin, injecting it in laboratory animals, and tracking it through their bodies with a Geiger counter, he finds out just what organs it affects. Hen's eggs injected with radiophosphorus tell Dr. Edward W. Shrigley, who uses them as germ incubators, what the virus of influenza feeds upon. Using radiophosphorus on wild-flower pollen, Dr. Norman H. Giles, Jr., investigates mutations or freaks induced by radioactivity.

Because of the peculiar affinity for iodine





**Slices of tomato** from plant nourished with radioactive zinc take their own picture when laid on photographic plate. Rays from isotope made this "radioautograph," showing zinc concentrated in seeds. (Photo from N. V. Philips' Gloeilampenfabrieken, Eindhoven, Holland.)



**Deadly toxin** of dysentery bacillus, the fluffy white substance in flask above, is "tagged" with radiophosphorus by Dr. Henry P. Treffers, of Yale medical school, to find out how it kills. When toxin is injected in animals, its course through body can be traced by rays emitted.

of thyroid tissue, radioiodine gives Dr. William T. Salter a triple-edged weapon against thyroid cancer. When cancerous cells migrate from the thyroid gland and settle elsewhere, a mild dose of radioiodine and a Geiger counter promptly detect the new focus of infection. A more powerful dose of radioiodine, used for therapy, bombards a cancerous growth at point-blank range and temporarily destroys it—a treatment to which a number of patients owe their lives. Thyroid glands from radioiodine-treated rats, placed on photo film, take their own pictures—"radioautographs"—which may lead to a more permanent cure.

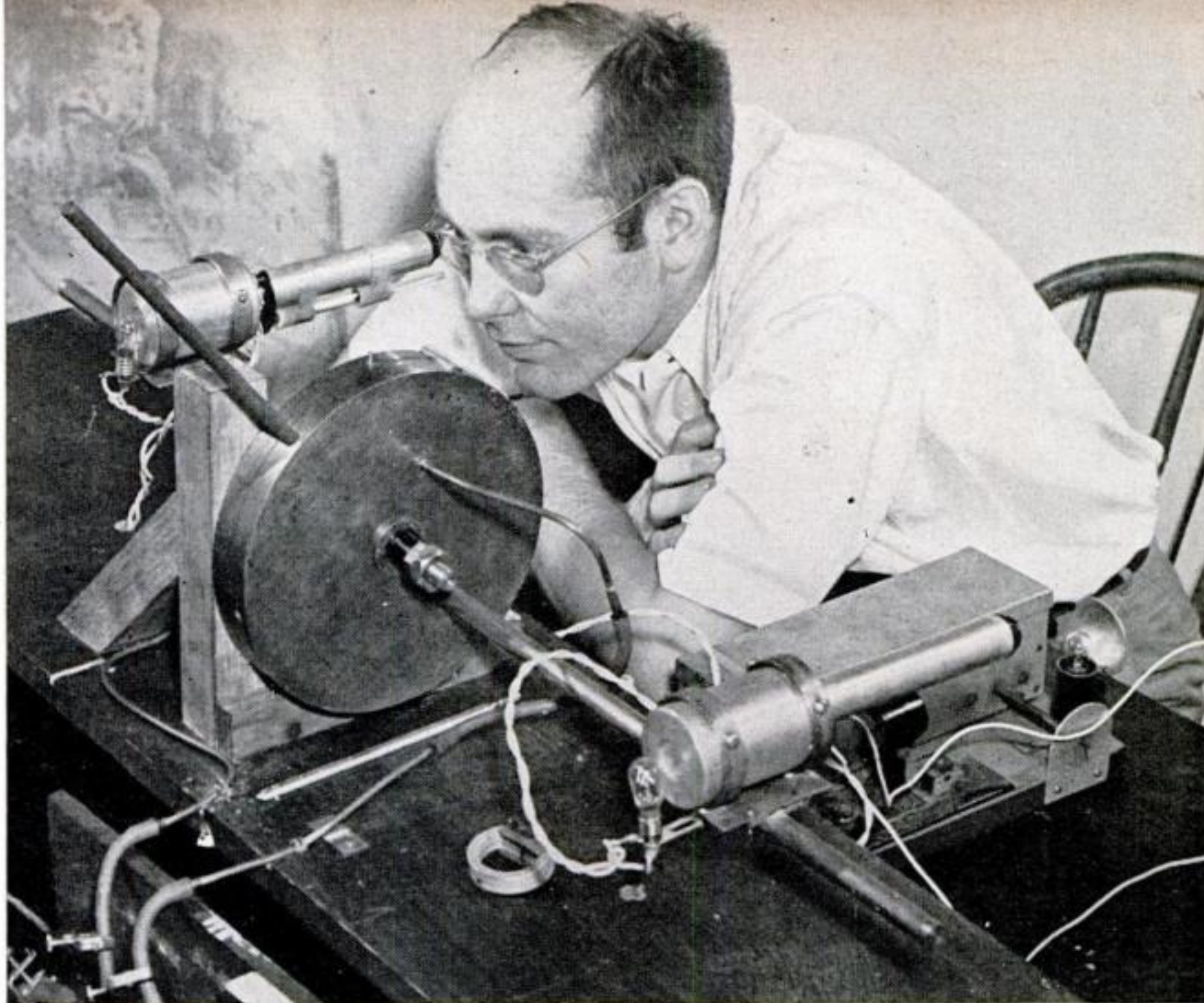
Radiomanganese may answer a teasing question for Vaughan T. Bowen, research assistant in zoology. Why do wasps and clams, two apparently unrelated members of the animal kingdom, contain 40 to 50 times as much manganese as other creatures? Yale's 27-inch cyclotron supplies this "homemade" radioisotope, which cannot be made by neutron bombardment in the pile. The cyclotron also provides isotopes too short-lived to be shipped from Oak Ridge.

Some of the most perishable, shortest-lived isotopes enable Dr. Pollard to explore unprobed mysteries of the atom's nucleus in the physics department—research so important that it is supported by funds from

the Office of Naval Research in Washington, D. C. It takes fast footwork to get a sample of radioactive neon gas from the cyclotron to a near-by laboratory in time to measure the energy of its rays with a magnetic lens, for it has a half life of only 40 seconds. Radioactive argon gas, used in a diffusion experiment, has a half life of two hours. A "decay clock" devised by Dr. Pollard (page 87) shows experimenters at a glance how fast their material, and its rays, are running out. Interchangeable dials adapt the clock for different isotopes.

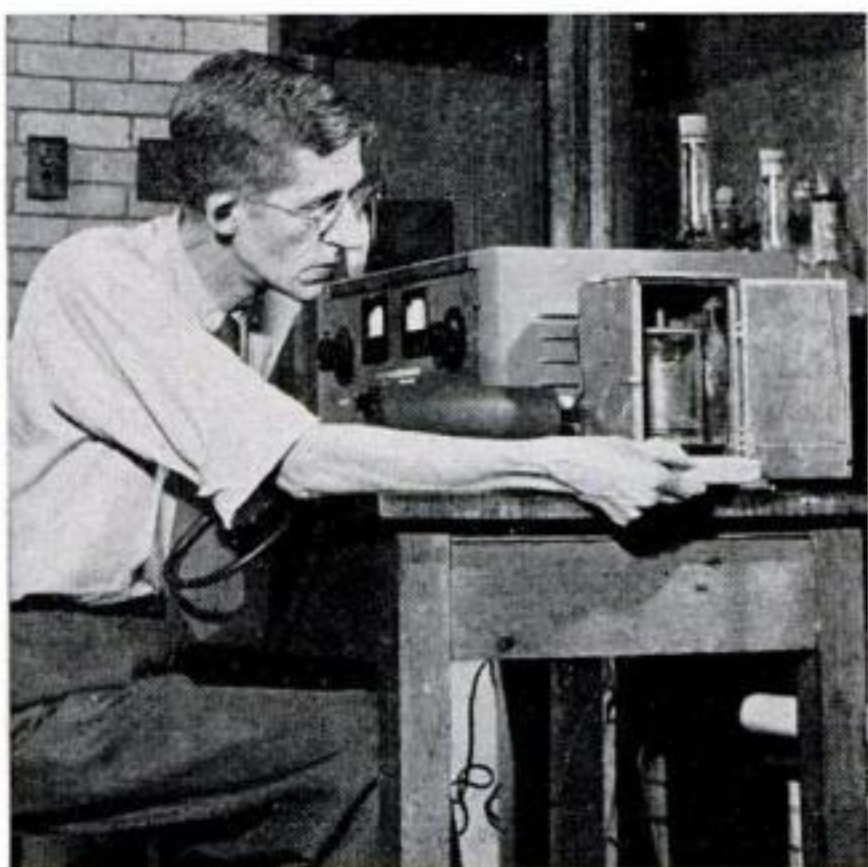
It was in Yale's physics department, in 1906, that Prof. Bertram B. Boltwood started off the list of known isotopes by discovering ionium, a lightweight twin of thorium. More than 670 isotopes have been found since then. About 270 of them are stable, like ordinary and double-weight hydrogen in "heavy water," or the 10 isotopes of tin to be found in the ordinary metal. The rest are radioactive, ranging in half life from less than a millionth of a second to more than 100 billion years. Most of these are man-made and unknown in nature. During the first year that they have been available in quantity, experimenters have hardly had time to do more than perfect the technique of working with them. Now, these new tools may reveal untold wonders. **END**





**Secrets of forces** between atoms are sought in diffusion apparatus at Yale physics laboratory. Tubes opposite central disk contain ordinary and radioactive argon gas. Observer has just opened aperture between tubes, allowing gases to mix. To measure speed of mingling, or

diffusion, he is peering into eyepiece of one of a pair of Lauritsen electrosopes mounted at outer ends of tubes. Movement of a hairline across a graduated field shows rate of increase in radioactivity at one end and decrease at other end, as the tubes exchange atoms.

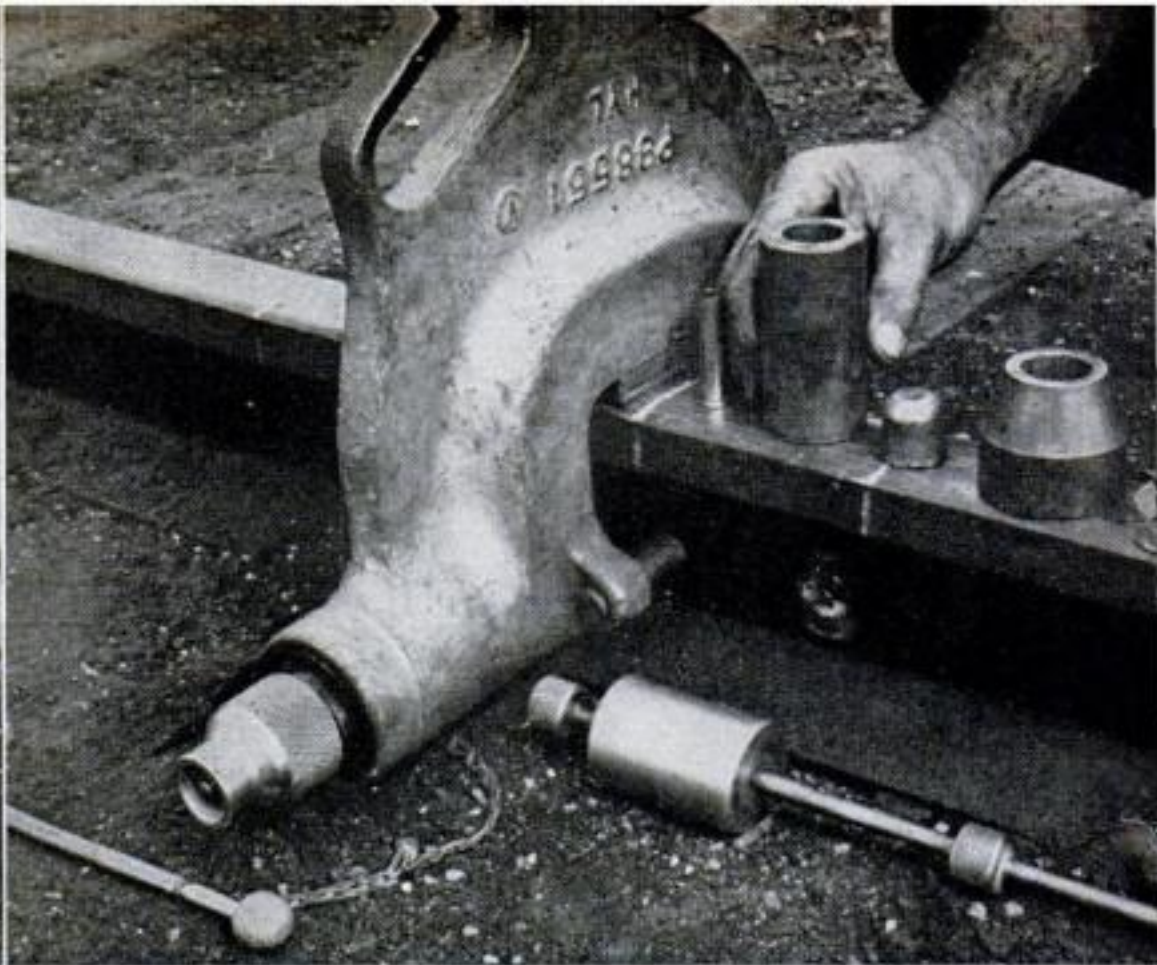


**Hitherto unknown sources** of natural radioactivity are sought by Dr. George M. Murphy of Yale chemistry department. Separating isotopes of rare-earth elements with adsorption column containing organic resin, he tests concentrate for rays with Geiger counter above.



**Getting rid of** used radioisotopes may pose future problem. Experimenters in this Yale laboratory pour them down drain. Sign warns of lingering rays that would contaminate laboratory glassware washed in the sink. They are too weak, however, to menace health of workers.





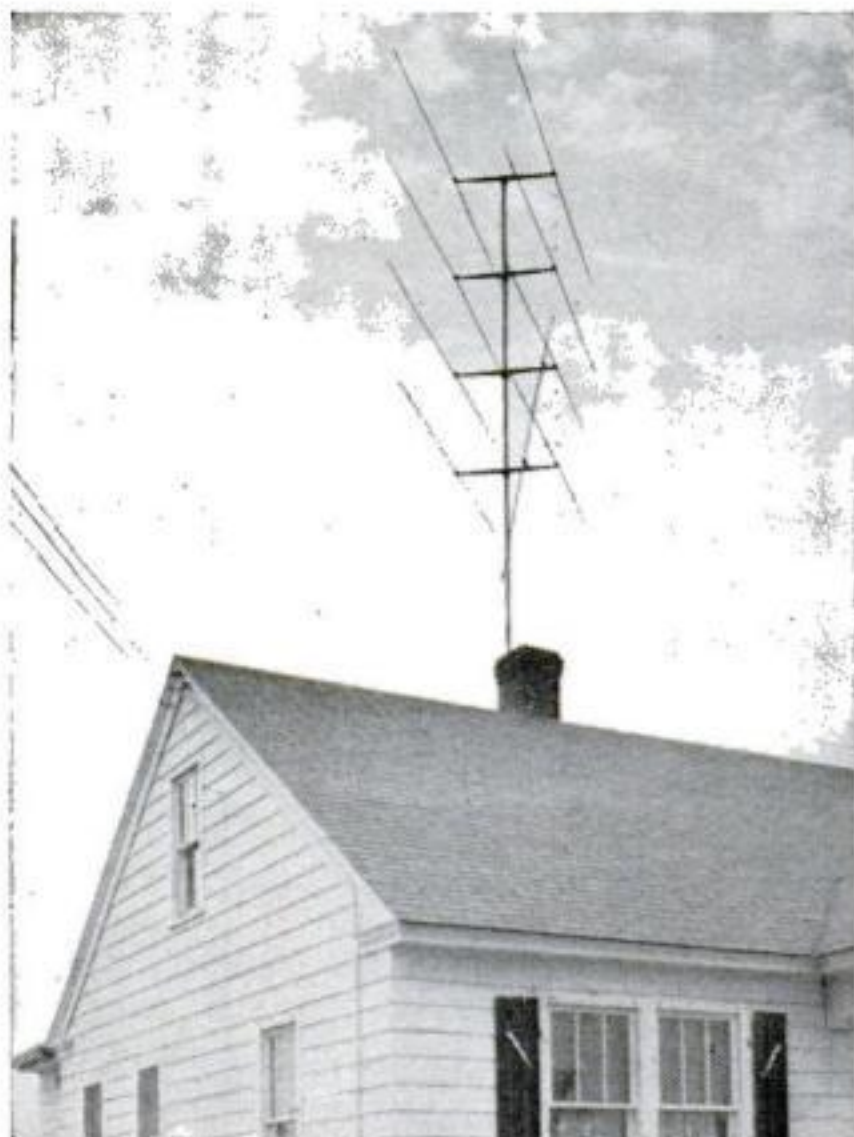
## Gun Shoots Rail Holes

THIS "cannon" speeds track-laying by shooting holes in steel rails. Made by Mine Safety Appliance Co., the 45-pound gun uses a cartridge slightly larger than a .45 to

blast a punch through  $\frac{3}{4}$ -inch steel. Tapping firing pin, at left above, sets it off. At right are (l. to r.) the gun, cartridge, barrel, punch, and breech; in foreground is a compressed-air ramrod. Punch—and resulting hole—can be up to  $1\frac{1}{2}$  inches in diameter.

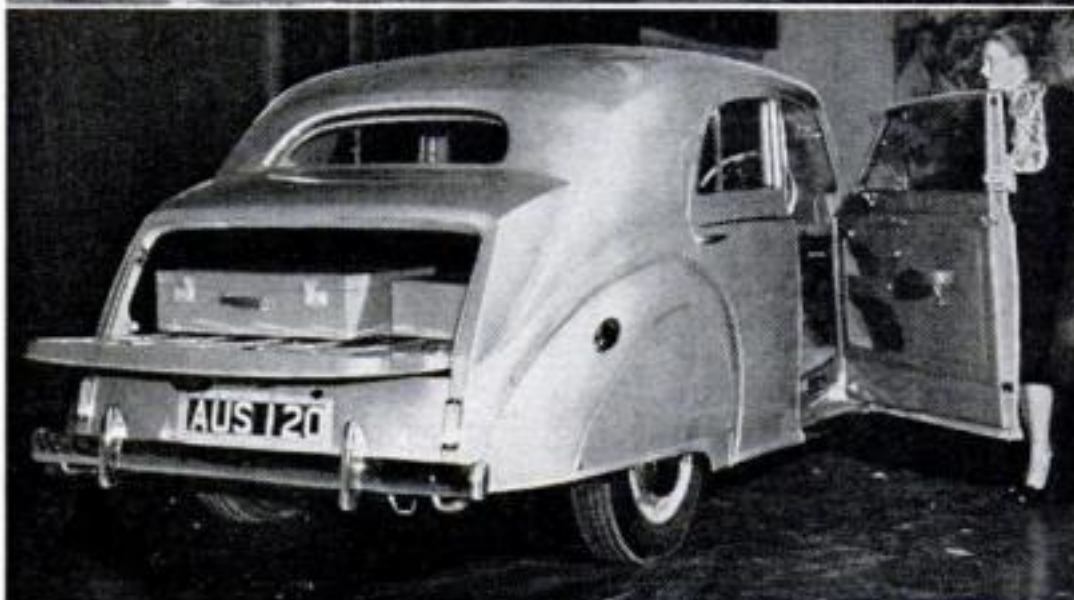
## Antenna Stretches Tele

THE Vee-D-X, a new long-distance antenna, makes television reception possible as far as 125 miles. It has high forward pickup, but little at sides and back, minimizing interference. Easily installed, it weighs 25 lb., has low wind resistance.



## Baby Austins Grow Up

THESE full-size, luxurious cars are two of the four new British-made Austins that will make their debut in 1948. The "Sheerline" (top, below) has a 6-cylinder, 130-hp. engine; the "Princess" (bottom) boasts 10 hp. more and many special features.





# How Germans Build Mud Homes

**G**ERMANS struggling to rebuild their shattered homes are going right back to Mother Earth. Dried mud blocks are being used for houses in a new settlement on a one-time drill field near Frankfort on Main.

Twenty-six houses, each of four or five

rooms and a basement, are to be completed this year. Some will be of prefabricated pressed wood and cement construction. The group, sponsored by the German Evangelical Relief organization, plans to expand as more building materials become available.



**First step is to dig clay** for the building blocks. Handcars are used to carry the material to a central point where it is mechanically mixed with loam and other ingredients.



**A former bank clerk** removes a mud block from the wooden mold in which he formed it. In background are stacks of blocks piled up to dry. Process is similar to making adobe brick.



**The first mud block** is set on top of the stone wall that forms the foundation of a house. White collar workers—including a former missionary—are members of the working crew.



**After the walls are up** and the roof on, workers polish the face of the earth blocks and coat them with a gypsum mixture to keep out moisture. Untreated wall can be seen at left.



# The Microwaves Are

Invisible network will handle phone calls, telegrams, television,  
FM and AM broadcasts, complete newspapers—even carry your mail.

**By Martin Mann**

*PSM photos by Robert F. Smith*

COMMUNICATIONS are being revolutionized faster than you think. The humming wires beside the highways already are rivaled by new systems, capable of transmitting more spoken or written words and more still or moving pictures from coast to coast. The difference between these new systems and those of the past is as great as that between oxcarts and stratoliners. Radio relay systems, coaxial cables, and other improvements in communications systems soon will bring you not only better, faster services such as you already know, but also completely new kinds of service.

Your radio program now comes to you in waves a fifth of a mile long. Your son's television program, and his telegrams and long-distance phone calls—even his mail—will come to him in waves only two or three inches long. Telegrams are now flying between New York and Philadelphia in these microwaves; phone calls will be made in microwaves next year between New York and Boston; and television shows are being sent this way now from New York to Schenectady and Philadelphia.

These microwave relays use invisible beams in the air instead of wires. No poles support them. The poles and wires are replaced by steel or concrete towers every 30 miles or so. On these towers are antennas that catch the microwaves, shunt them down to repeater equipment to be amplified, then send them on to the next station.

These relay stations are as automatic as

electric refrigerators—designed to operate with only occasional human supervision. If a tube fails, its duplicate is standing by, ready to switch into operation immediately without interrupting service—and at the same time to flash a trouble signal to the nearest testboard. A furnace heats each tower building in winter and in the summer it is cooled by air-conditioning devices for the machinery's benefit. Banks of batteries and current from the local utility companies supply the power. In some stations, a gasoline generator automatically starts itself and takes over the job of charging the batteries if the utility lines fail.

You will not notice any difference when your phone calls begin to go through these radio relays. On a call from New York to Boston, for example, your voice will travel as usual from the handset through the switchboard into a trunk line for Boston. That trunk line now is a thick copper, rubber, and lead cable buried in a ditch along the Atlantic coastline. When radio relay is used, however, the cable carrying your voice will end on the roof of the telephone building in lower Manhattan. There it will feed into a microwave transmitter, aimed at the first relay station atop Jackie Jones Mountain, N. Y., 35 miles away.

At Jackie Jones, a strange antenna that looks like a big square metal funnel will receive the beam. This antenna is a set of criss-crossing metal plates that focus microwaves into a narrow beam. From this lens, the beam will travel down into the tower to amplifiers, to be strengthened after its 35-mile trip. It will then go back up to a



Seven automatic towers will relay microwave beams from New York to Boston in a

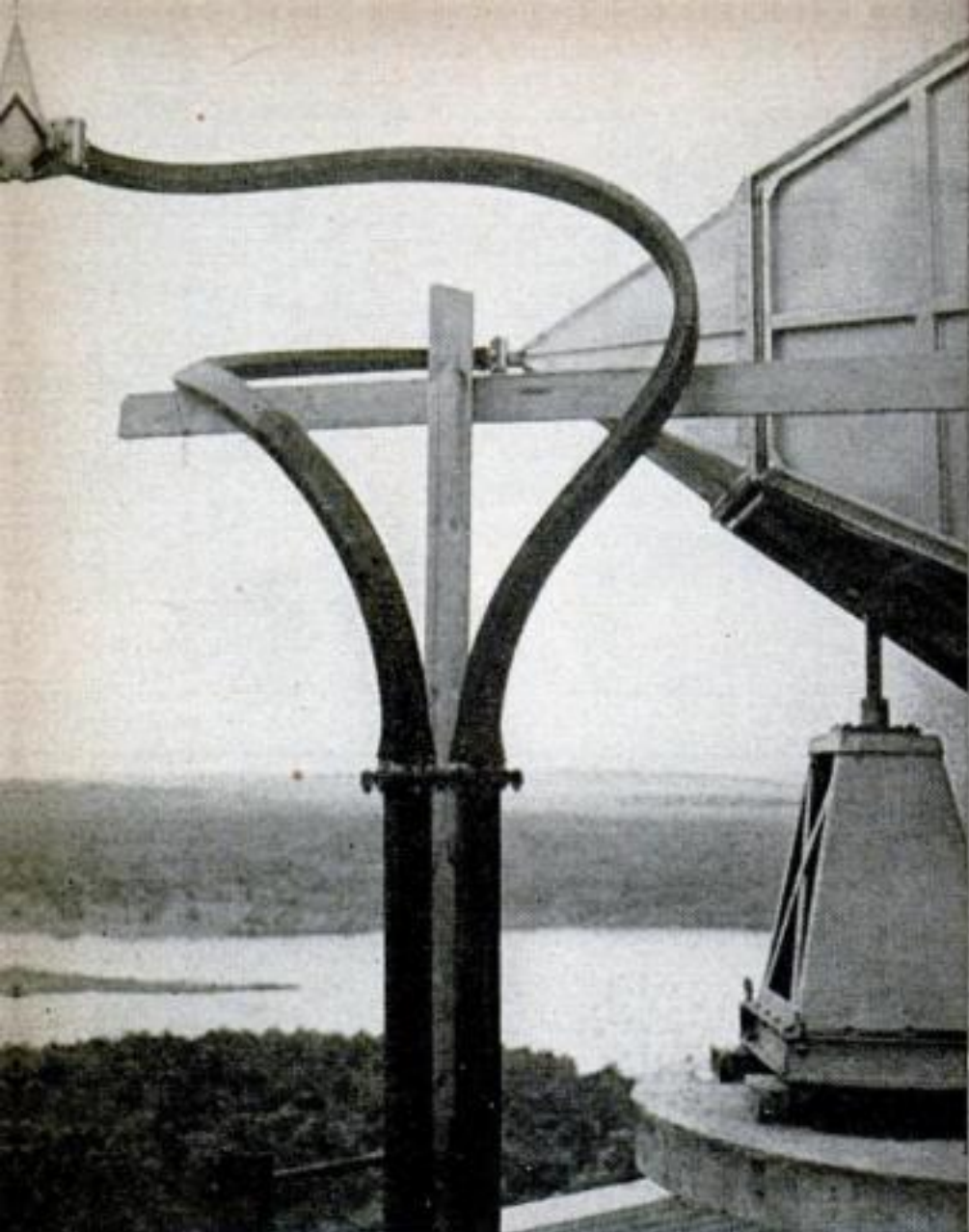


# Coming!

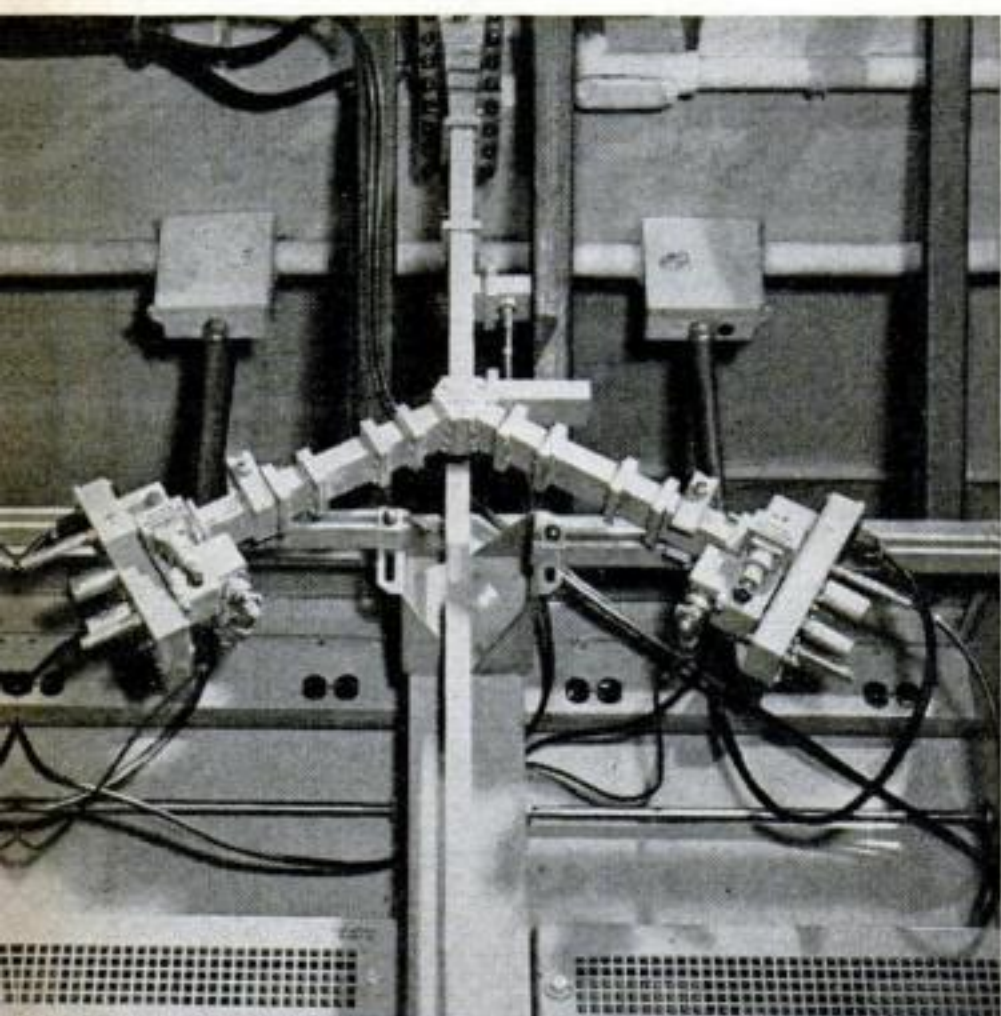


telephone system, soon to begin operation. Large picture shows layout of one tower.

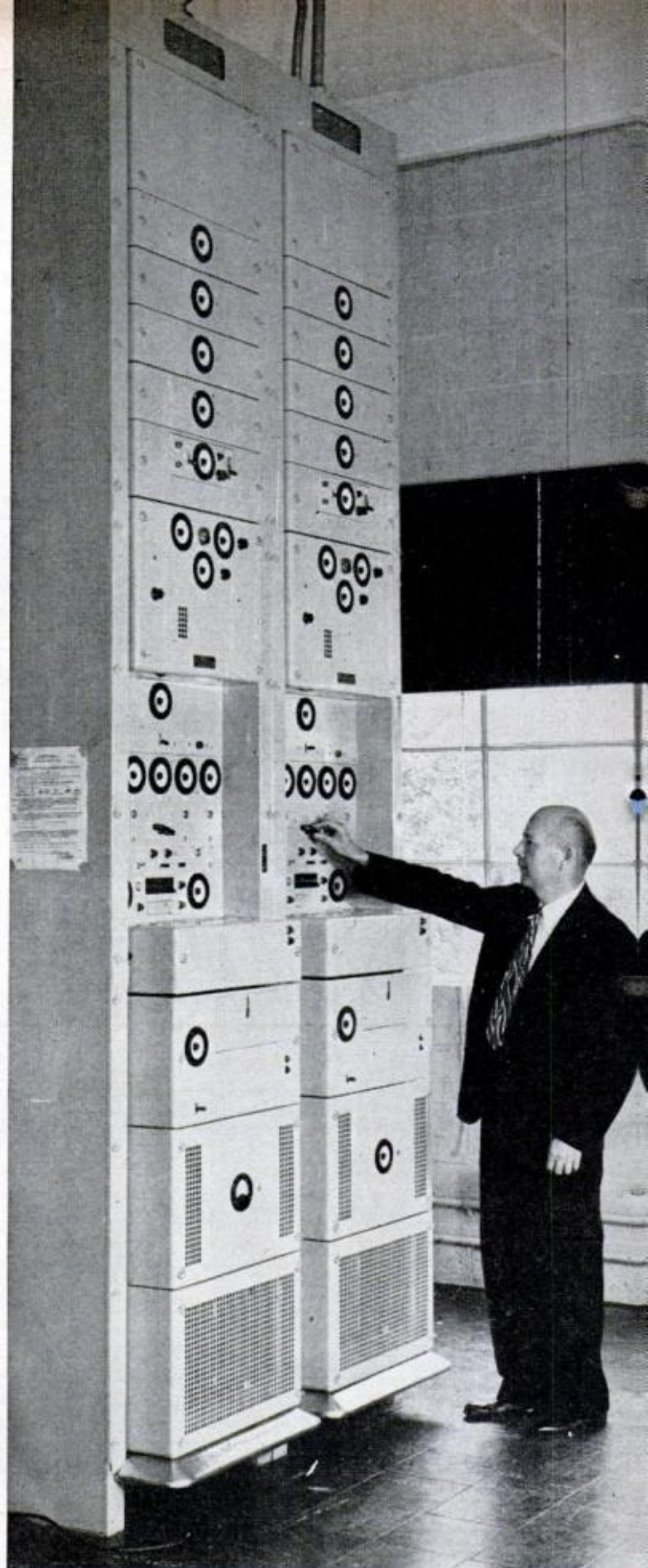




**Hornlike metal lenses** serve as antennas, one receiving, the other transmitting, microwaves. They focus the waves into narrow beams the way light is focused by glass lenses. The focused beams travel to and from the amplifiers below in the gracefully curving wave guides, which are hollow square copper pipes.



After passing through the roof, the wave guides come down behind the amplifiers and divide into Ys that split the beam into two channels. The Y shown is the receiving end; transmitting Y is near bottom of amplifier.



An engineer adjusts amplifying equipment on one of the two microwave channels from this relay tower to the terminal station. A similar pair of amplifying panels (out of picture to left) controls channels going the other way.



second lens, which will aim it at the next relay station on Birch Hill in Connecticut. This process will be repeated in each of seven relay stations until your voice reaches the receiving lens on the Boston telephone building and goes into wires again.

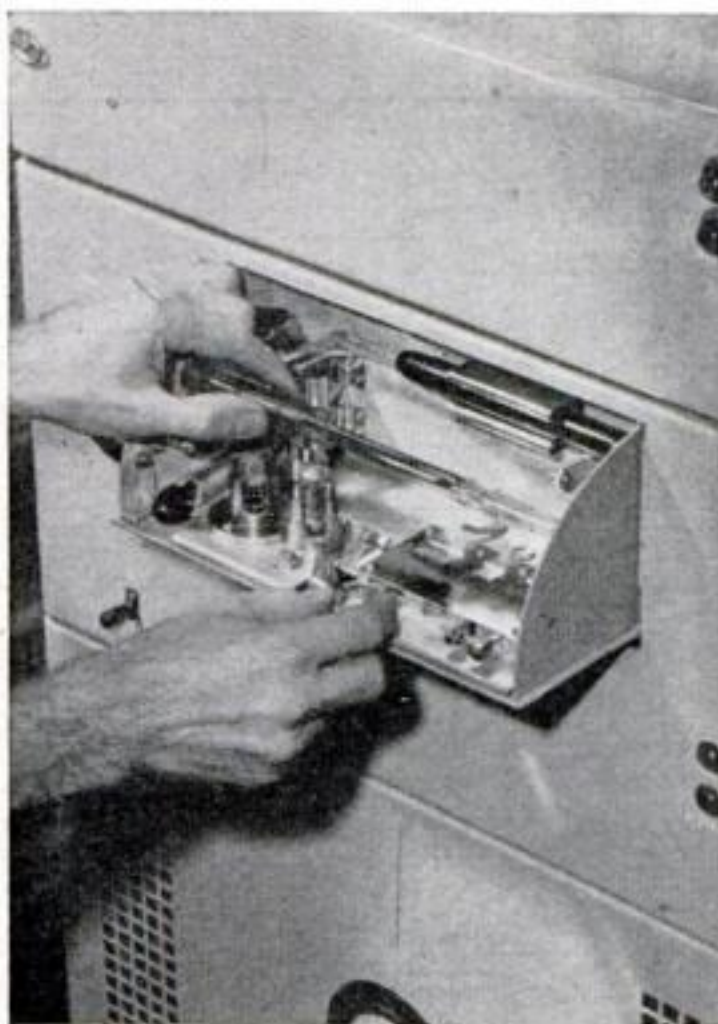
The Bell System already has the equipment installed for this New York-to-Boston chain of relay stations and is working on chains from New York to Philadelphia and Chicago. These relays will be capable of handling television shows as well as phone calls. Western Union now is using a radio relay system developed by the Radio Corporation of America between New York and Philadelphia, will soon send telegrams from Pittsburgh to Washington the same way, and expects every main telegraph route in the country to be a radio relay system within a few years. The General Electric Co. is now transmitting television shows from New York to Schenectady, and the Philco Corporation has a similar link between New York and Philadelphia television stations.

The beams transmitted and received by the relay stations are so narrow that it would be difficult to tap them. This is one of several reasons for using extremely high frequencies (around 4,000 megacycles, several thousand times as high as those of ordinary broadcasting stations). At such fre-

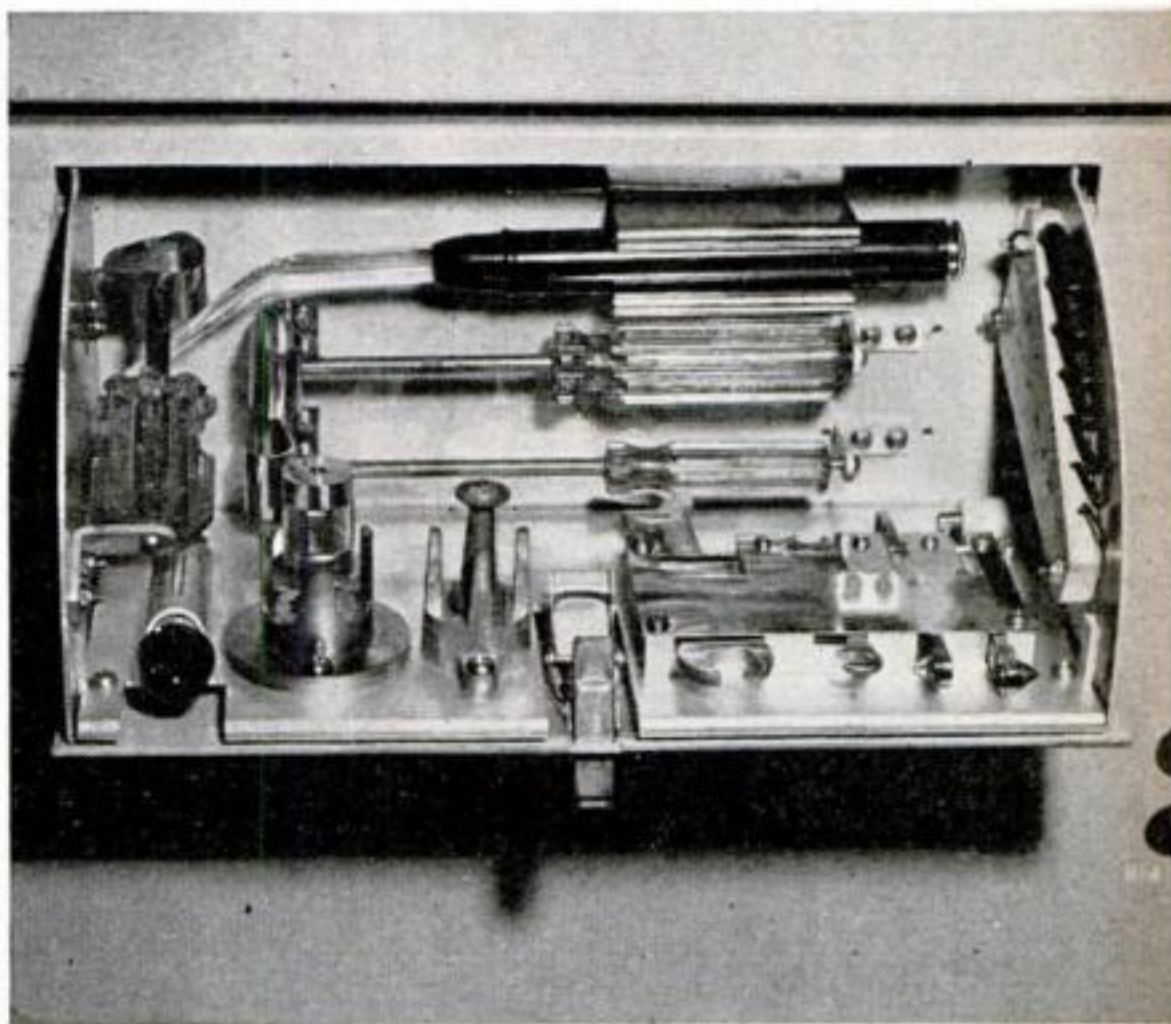
quencies, the energy can be focused into beams so narrow that 100,000,000 times as much of it reaches the receiver as would otherwise. Most microwave transmitters produce only one watt of power, as compared to the 1,000 to 500,000 watts scattered by lower frequency radio stations.

Microwave beams, moreover, are not bothered by sunspots, thunderstorms, man-made electrical interference, hail, sleet, or snow. Since the towers are always on hills, even floods will seldom cause trouble. But the big reason for high-frequency beams is their tremendous carrying capacity. Several hundred people will be able to talk at the same time over Bell System's New York-Boston beams.

Radio relays, however, are not the only means of increasing the capacity of a communications system. Much further developed than radio relays for telephone service is the coaxial cable, which is basically a copper tube with a wire running down the center. "Coax" already is being used both for telephone and television service. The cable must be buried in a deep ditch, and many amplifiers are needed, but the Bell System's experience with coaxial cable has been so gratifying that more of it is being laid rapidly. By 1950, 12,000 miles of such cable will have been laid to link practically

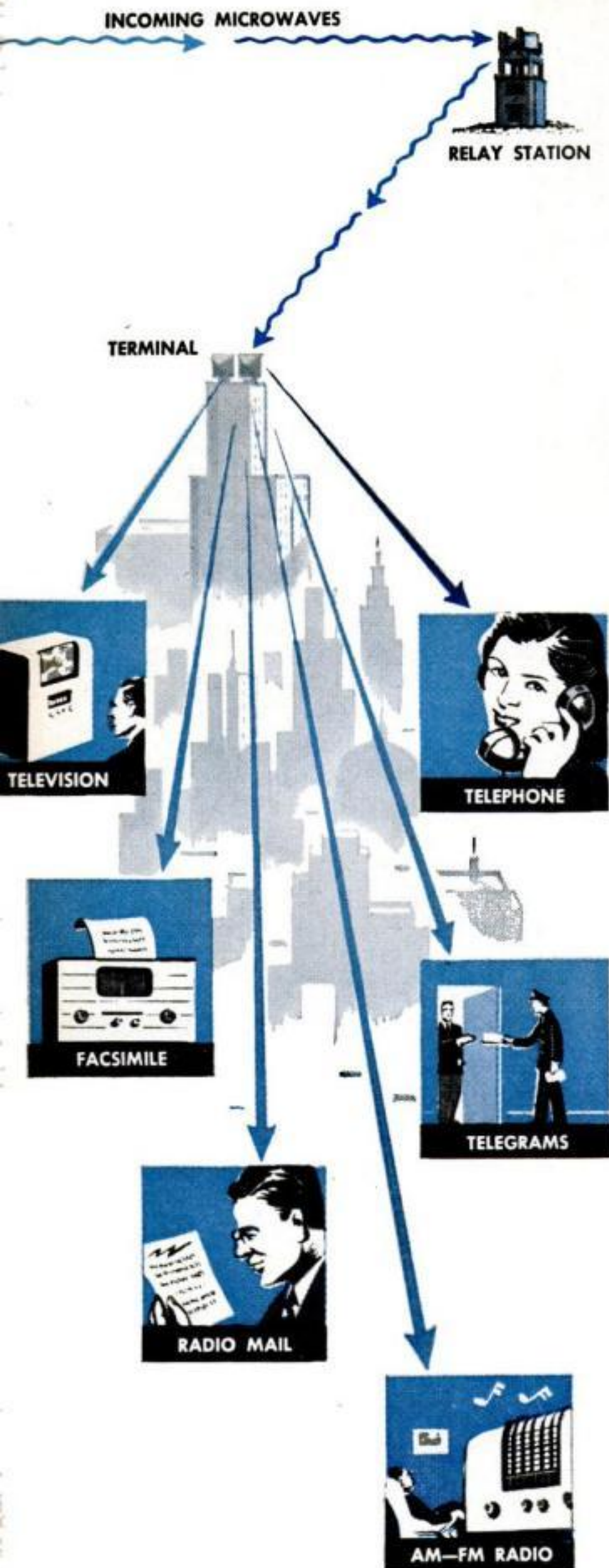


**Repairmen can never complain** that they forgot a tool—everything needed for maintenance of relay equipment is included in a rack built in each panel (left). In addition to ordinary tools such as screwdrivers and lucite-lensed flash-



light (see close-up at right), there are special gadgets like prong-straighteners for the tubes (left of center). Refinements like this help make the relay stations so self-sufficient that little supervision is required.





**Coin-in-the-slot** facsimile machines are already being developed to flash your wires across the country in a fraction of a second. This model (not coin-operated) is now in use to feed messages from hotels and business offices to the big central exchanges of Western Union.

every major city in the United States.

The ability of radio relays and coaxial cables to carry more traffic will solve the major problem of the communications companies: how to handle more business. The wire networks have been called upon to carry an ever-increasing load of phone calls and telegrams. On top of that, there are new kinds of business that will not fit well on the wires—television, FM, and high-speed facsimile. Existing wires will continue to be used for comparatively short-distance phone calls and telegrams, but the burden imposed by the addition of new services will be handled largely by the new systems.

Television is the greediest customer. A television show can be sent over ordinary wires, but many amplifiers are needed and a coast-to-coast hookup by such wires is impractical. Even microwave equipment at present will carry only one television program per channel, because that is all the amplifiers can take. Better amplifiers, like the traveling-wave tube (PSM, Nov. '46, p. 111), are being developed, however, and may increase the capacities of microwave systems.

Already, too, scientists are working on another kind of wire that possesses almost limitless carrying capacity—wave guides, which are just what the name suggests: copper pipes that guide waves. In a wave guide, the radio wave travels in the empty space inside, not in the copper itself. The

**The microwave relays** will serve as a trunk-line highway for all kinds of communications, as illustrated in the above drawing. Radio is used only to carry traffic to the city terminal; it is distributed from there to users on wires.





Photos by A. T. & T.



**Coaxial cable** can also provide communications networks geared to present-day needs, capable of transmitting television programs, facsimile, FM radio, and many phone calls and telegrams. This machine (left above) lays coaxial cable almost automatically. It digs the ditch, puts

cable down, and then fills in the ditch—and even guides itself around obstacles. When one reel of cable is used up, however, handwork becomes necessary. The beginning of the new reel must be spliced to the end of the old one, a painstaking, delicate job (right above).

copper serves only to hold the wave in place. Engineers call the waveguides “plumbing” because they look and work like the water pipes in your home.

Waveguides already are being used in radio relay stations (and radar sets, too). They carry the microwaves the few feet from the receiving antennas to the amplifiers and back to the transmitting antennas. Waveguides promise to be the ideal means of communicating intelligence when present difficulties are ironed out. A single pipe could carry all of the communications between the Atlantic and Pacific coasts. It could take every phone call and telegram now handled by hundreds of wires and still have plenty of room left for television, FM, and facsimile. As a long-distance path for communications, however, waveguides are still in their infancy.

Networks of some kind, capable of delivering television and FM service to every home in the country the way wire networks now carry standard broadcasts, will be available in the very near future. They will also make possible such spectacular services as radio mail, a system of high-speed facsimile which may replace telegrams and air mail by speeding your letters across the continent at the rate of a million words a minute.

Radio mail equipment is being perfected now by RCA and Eastman Kodak under the name of Ultrafax. This equipment will com-

bine photography and television to flash any kind of written material over a great distance almost instantaneously. Letters, books, newspapers or what have you will be first photographed on motion picture film. The film then will pass before the lens of a special television camera that will convert it to a radio wave and send it over a microwave relay or a coaxial cable to a distant receiver. There an electron beam will “write out” the material on unexposed film. After fast processing, this film will reproduce the original.

David Sarnoff, RCA president, says Ultrafax will be capable of sending 40 tons of air mail from coast to coast in a single day. Besides letters, Ultrafax will be able to send newspapers over the air, perhaps even in the middle of regular television broadcasts. E. K. Jett, of the Federal Communications Commission, suggests that Ultrafax might be used to transmit a whole issue of the *New York Times* from New York to San Francisco during the few seconds between programs. The screen on a home television receiver would darken while the announcer said, “This is WNBT, New York,” and in that instant the picture frequencies would be used to send the whole newspaper. With the help of modern, high-speed methods of reproduction at the receiving end, San Franciscans could get their copies of the *Times* as soon as New Yorkers! **END**

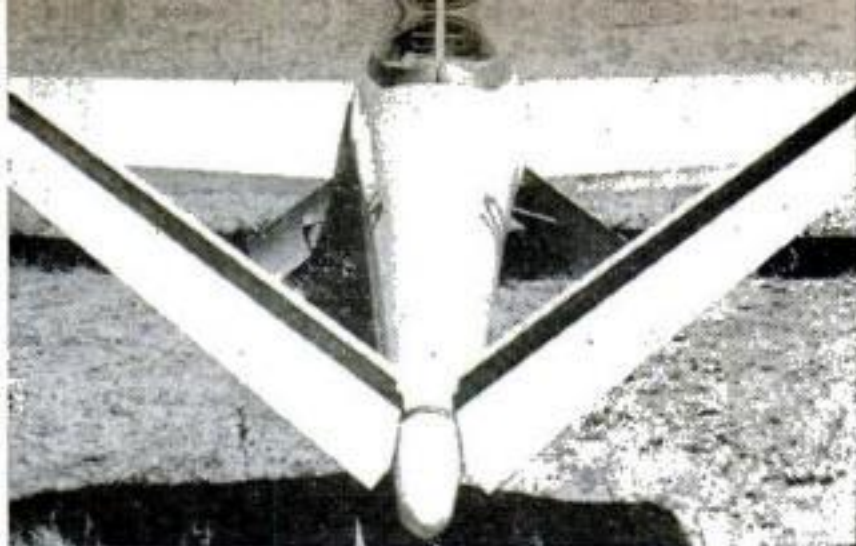




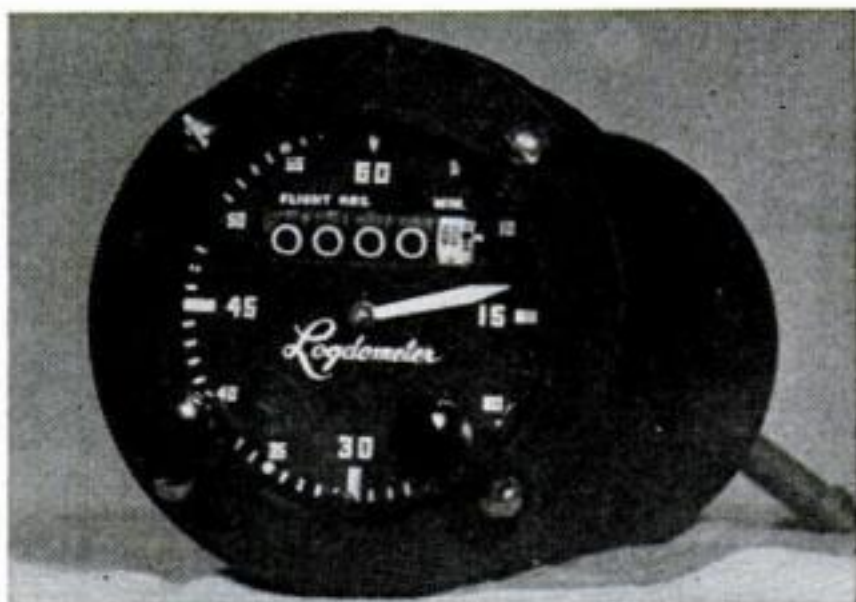
## WHAT'S NEW IN AVIATION



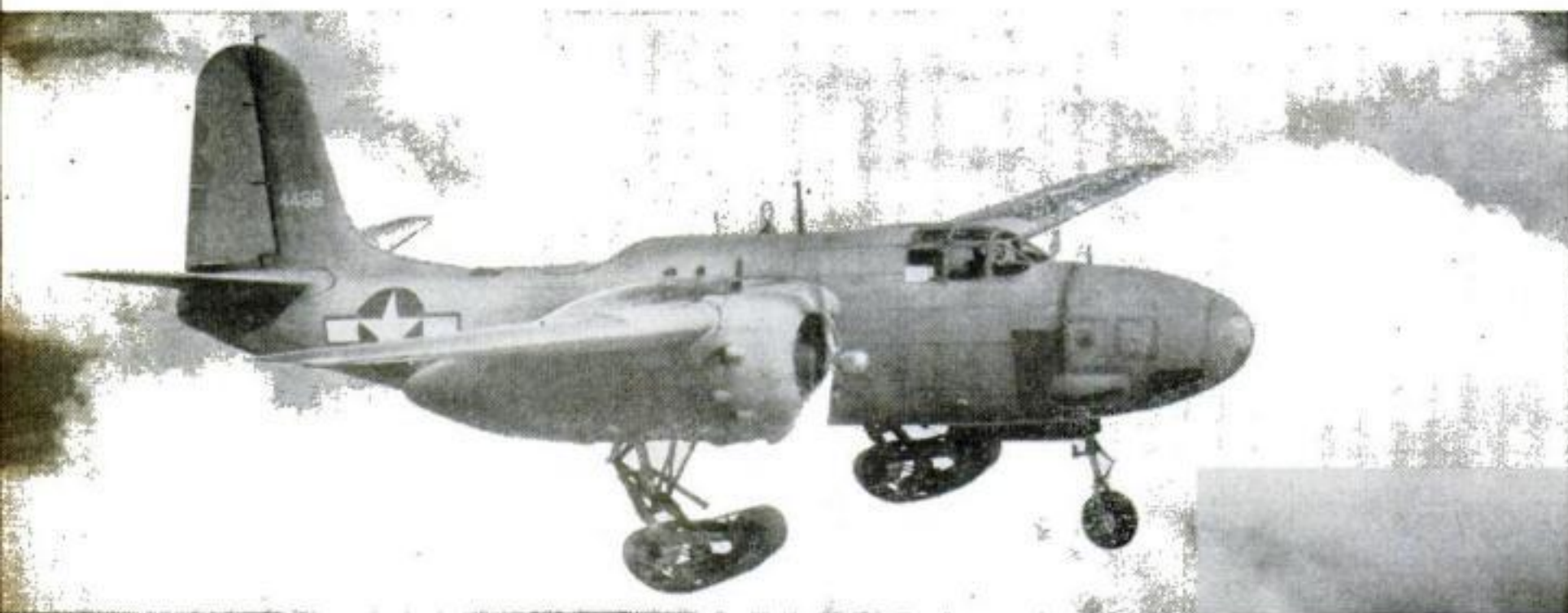
**Tower Tests Rotors.** This 40-foot cone at Langley Field, Va., is the NACA's device for testing performance of helicopter rotors without bothering to send them aloft. Instruments in the tower measure thrust and side forces, blade pitch, wind, engine r.p.m., and many other factors, while oscillographs record all data for analysis.



**Sailplane Shuns Bulk.** Said to be the smallest and lightest sailplane in the world, the V-tailed craft above is only 16 feet long, has a 36-foot wing, and weighs 185 lb. Built by Irving Prue, Lockheed engineer, it is made almost entirely of magnesium shaped by heating in an ordinary kitchen stove. Projections at side of fuselage are air brakes.



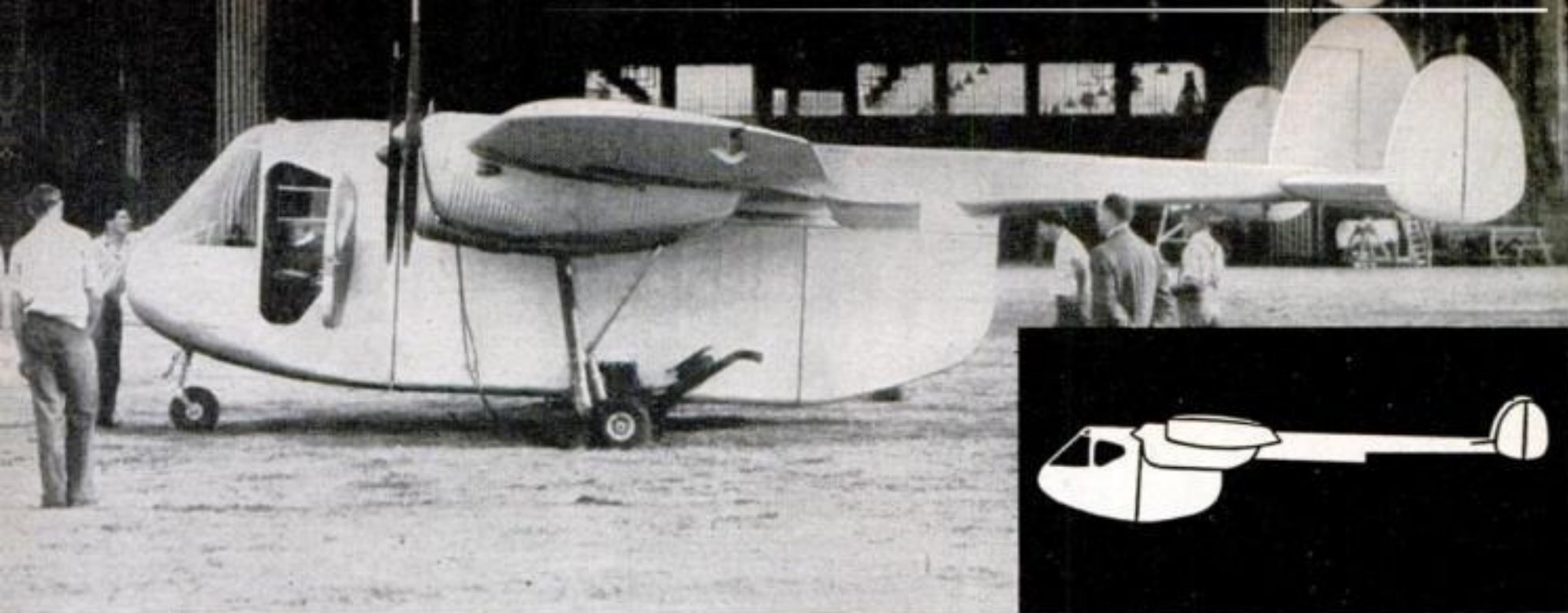
**A Timer Runs Itself.** Spring-driven and actuated by airspeed, the Logdometer automatically records a plane's time aloft, can be set to clock flight check points.



**Trying Out Tractor Gear.** An Air Force guinea pig, this A-20 has been fitted with the tractor landing gear under develop-

ment for heavyweight planes. In one test, the plane ran over an eight-inch-square timber at 90 m.p.h. without damage.





**Trailer Grows Wings.** For transport to and from airports, the Miles M-68's freight compartment turns into a trailer. The center of the fuselage is detachable (the four-engine British carrier flies with

or without it) and has removable wheels and a towing bar. The plane is shown above with its freight container in place; silhouette shows rear of fuselage moved up to complete the cabin with the container left out.



**Transatlantic Air Liner.** France's six-engine Latecoere 631, destined for the South Atlantic run, has a wing span of 188

feet, a cruising speed of 185 m.p.h., and carries 46 passengers on long-range flights. Ten of the flying boats are being built.



**Four-Jet Fighter.** For flying and for fighting blind in any weather, even in the Arctic, the Air Force now has the big

Curtiss XP-87, its first four-jet fighter. Sixty-five feet long, with a span of 60 feet, it may do better than 600 m.p.h.



# Boys Build A Cyclotron

**This little atom smasher, designed by California high school students, works just like the big ones.**

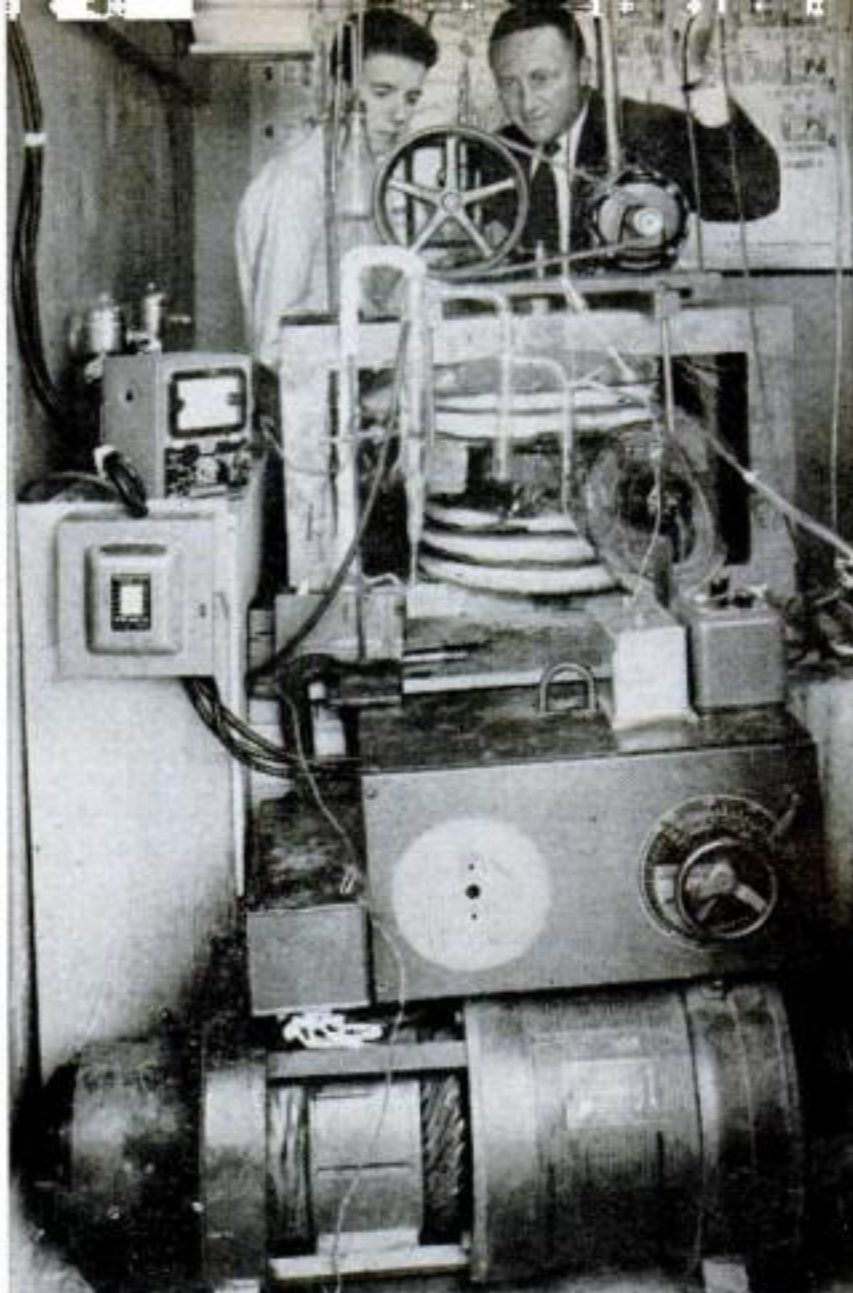
**By Andrew R. Boone**

**T**HE young nuclear physicist who won the Nobel prize by developing the cyclotron, Ernest O. Lawrence, started out with a little glass device that looked like a frying pan. Since then, cyclotrons have become such mammoth, complex, and expensive machines that the patent holders are rarely bothered by requests for licenses to build them. But ingenious and industrious youngsters can still build cyclotrons.

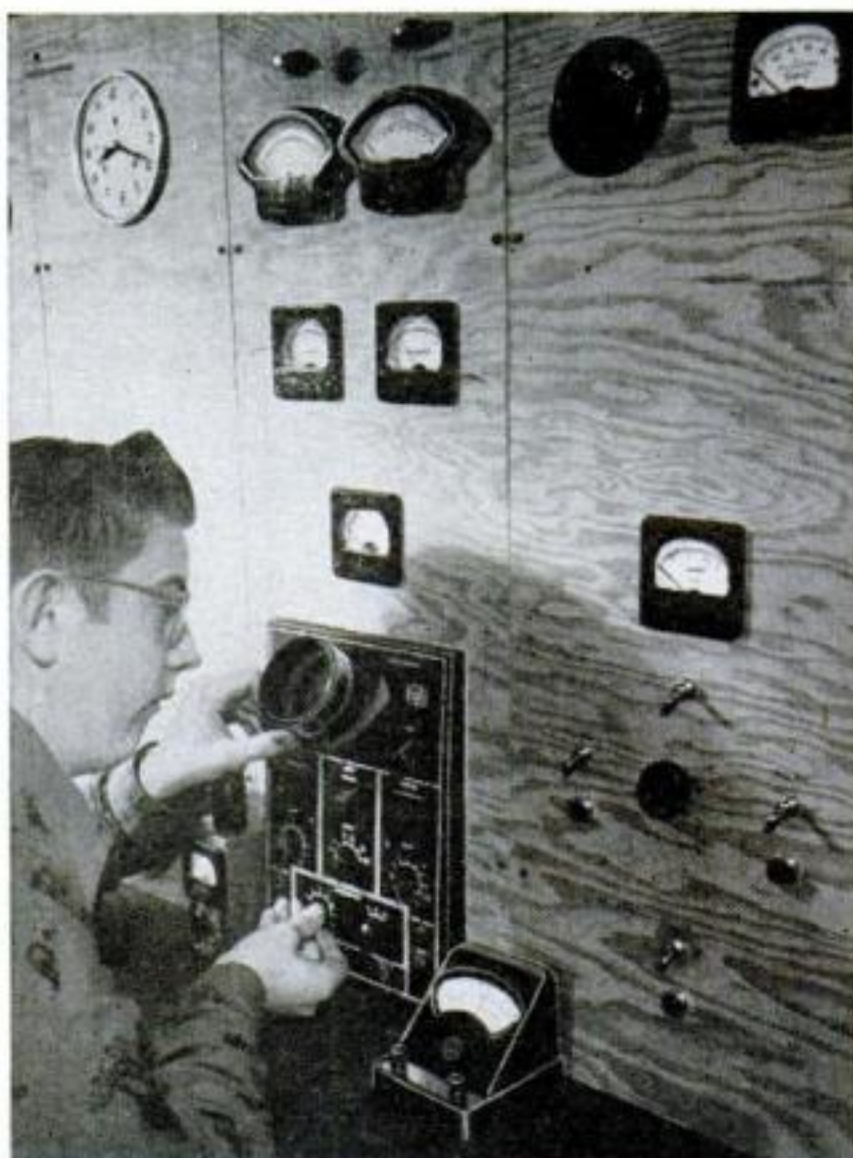
This was proved recently at the El Cerrito, California, High School, where four students of instructor Ben Siegel built their own cyclotron, put it in a room scarcely any larger than a clothes closet, and operated it by remote control from a homemade, plywood instrument panel.

They neither asked nor received any help from the Atomic Energy Commission. They found, when they had completed it, that they probably had infringed on patents granted to Dr. Lawrence and assigned by him to the Research Corporation of New York, but officials of the latter waived royalty claims. So the students now are planning to use their machine to produce their own radioactive isotopes for further experiments. They plan to shield near-by workers with tanks of water three feet thick.

A cyclotron is a machine for speeding up subatomic particles by giving them a series of relatively weak electrical pushes while they whirl around in ever-widening circles. This is done by placing the acceleration chamber between the poles of a magnet and maintaining a high vacuum within the chamber to prevent air from retarding the tiny particles. When finally allowed to fly out of their circular path, the particles have

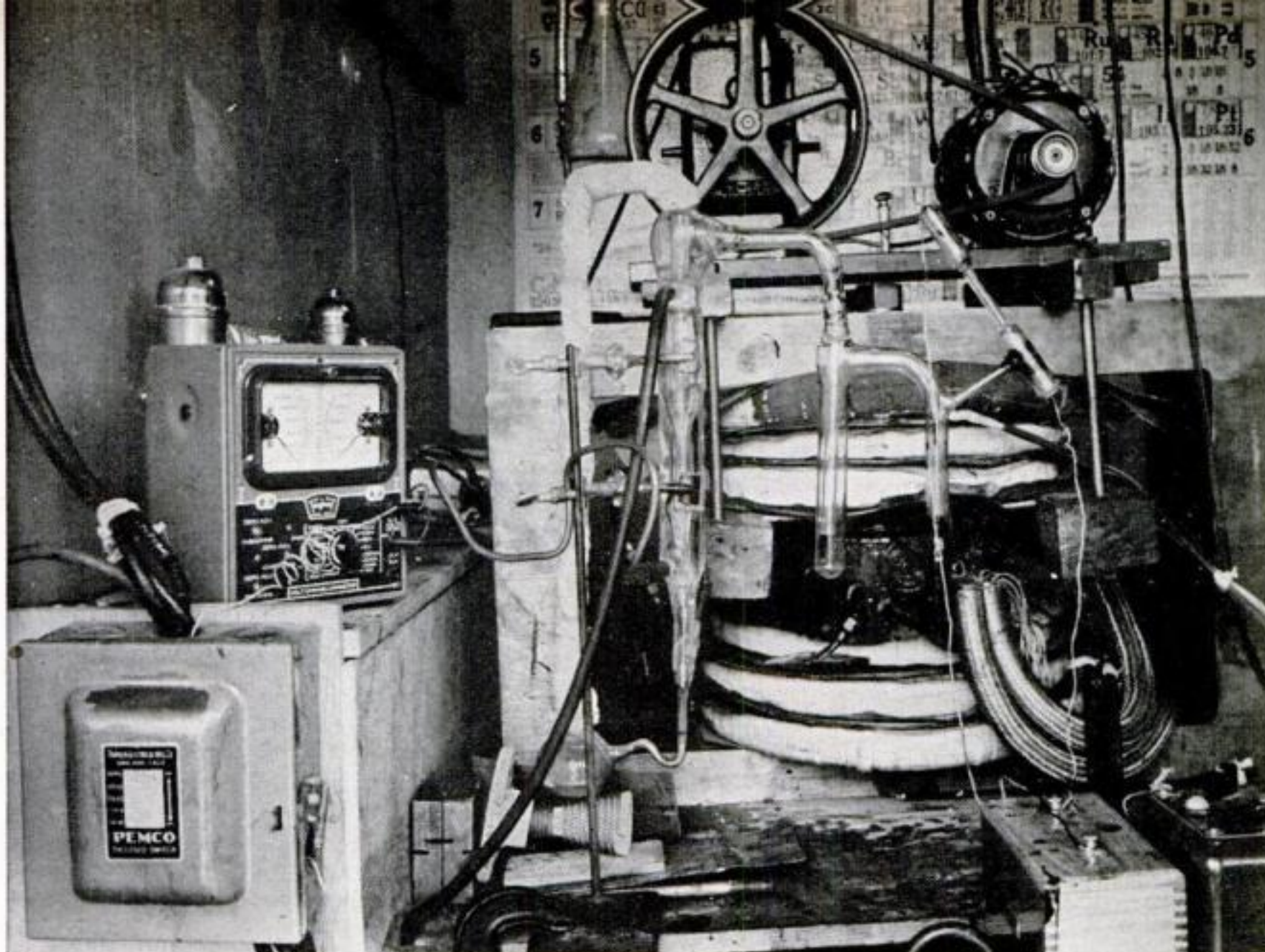


**This one-ton, million-electron-volt cyclotron is five feet high and 2½ feet square. It was built by four boys and their teacher in three months at a cash outlay of only \$500.**



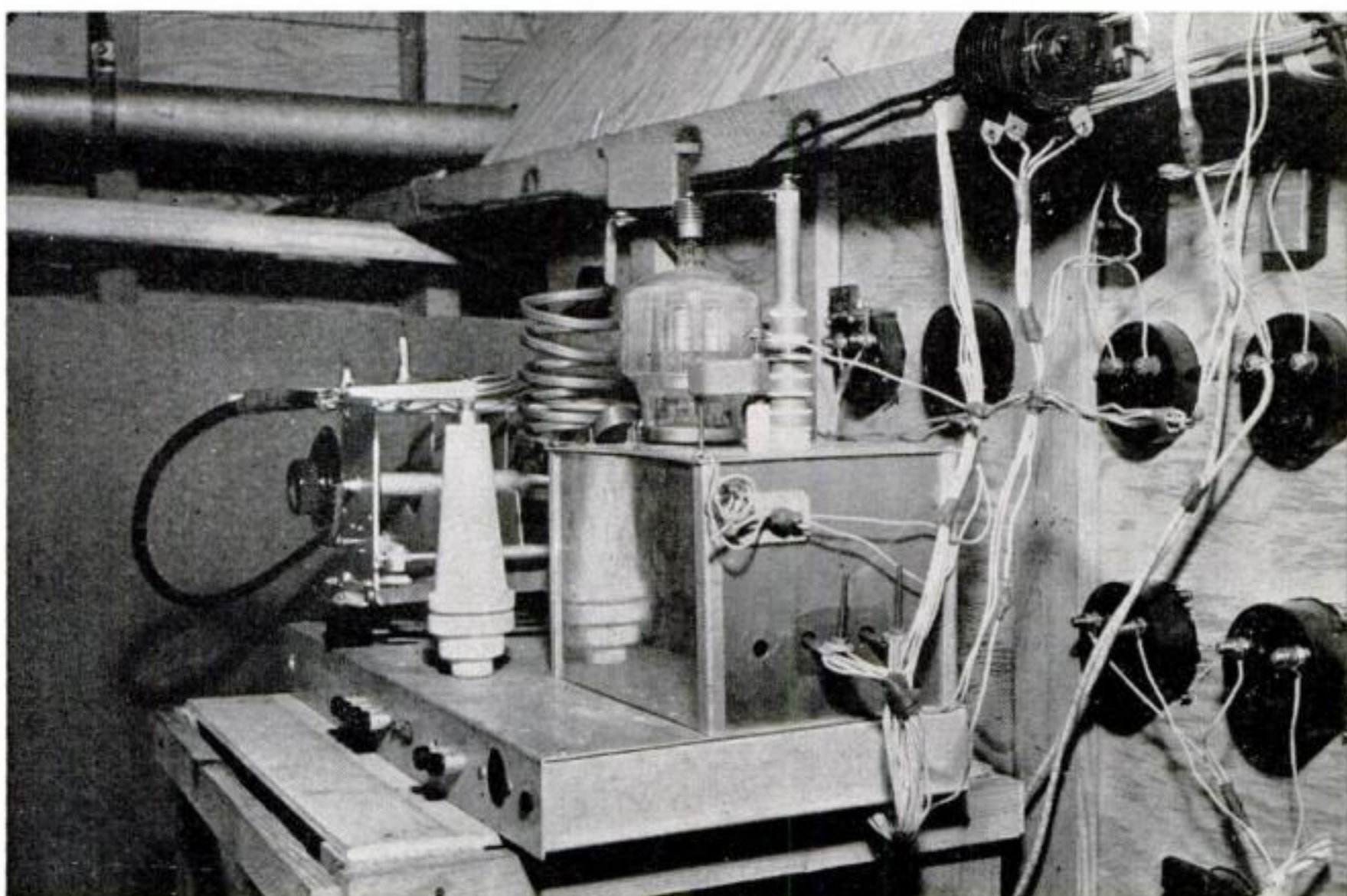
**The instrument panel, 3½ by 7½ feet, was built in sections to make servicing easier. Most of the instruments used were built by the boys or revamped from Army surplus items.**





**Motor and pump** on top are used to start a vacuum in the accelerating chamber. The pronged glass tubing in front is a mercury diffusion pump, which completes the job of creating

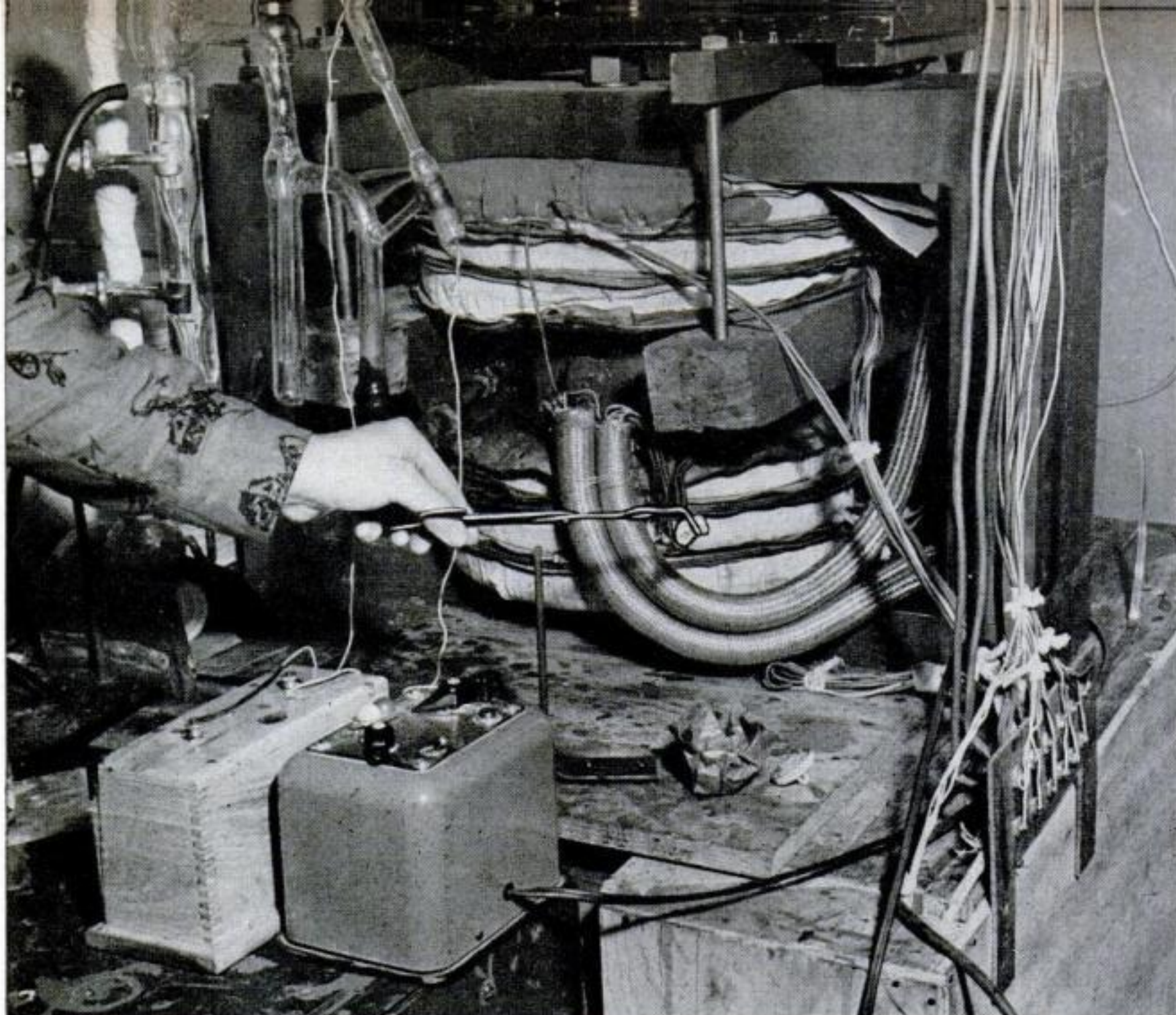
the vacuum. Those things that look like pancakes are the coils around the poles of the magnet. The acceleration chamber is located between these two sets of coils.



**Power transmitter** shown here is located in a room above the cyclotron, and its output is delivered by a variable link coupling and shielded coaxial cable. Transmitter operates on 2,000

volts at one ampere, and puts out 1,500 watts of power on a 20-megacycle frequency. The system is designed to handle a larger, heavy-duty chamber the boys are planning.





**To place a target** in the path of the speeding particles, the operators will use tongs and an opening only  $\frac{1}{2}$ -inch in diameter near the inlet of the U-shaped coaxial cables.



**When radioactive isotopes** are produced, they will be removed from the cyclotron and placed in a cup as shown above, to be wrapped in foil. Gloves will be worn to prevent injury.

so much energy that they can be used as bullets against the atoms of whatever substance has been chosen as a target.

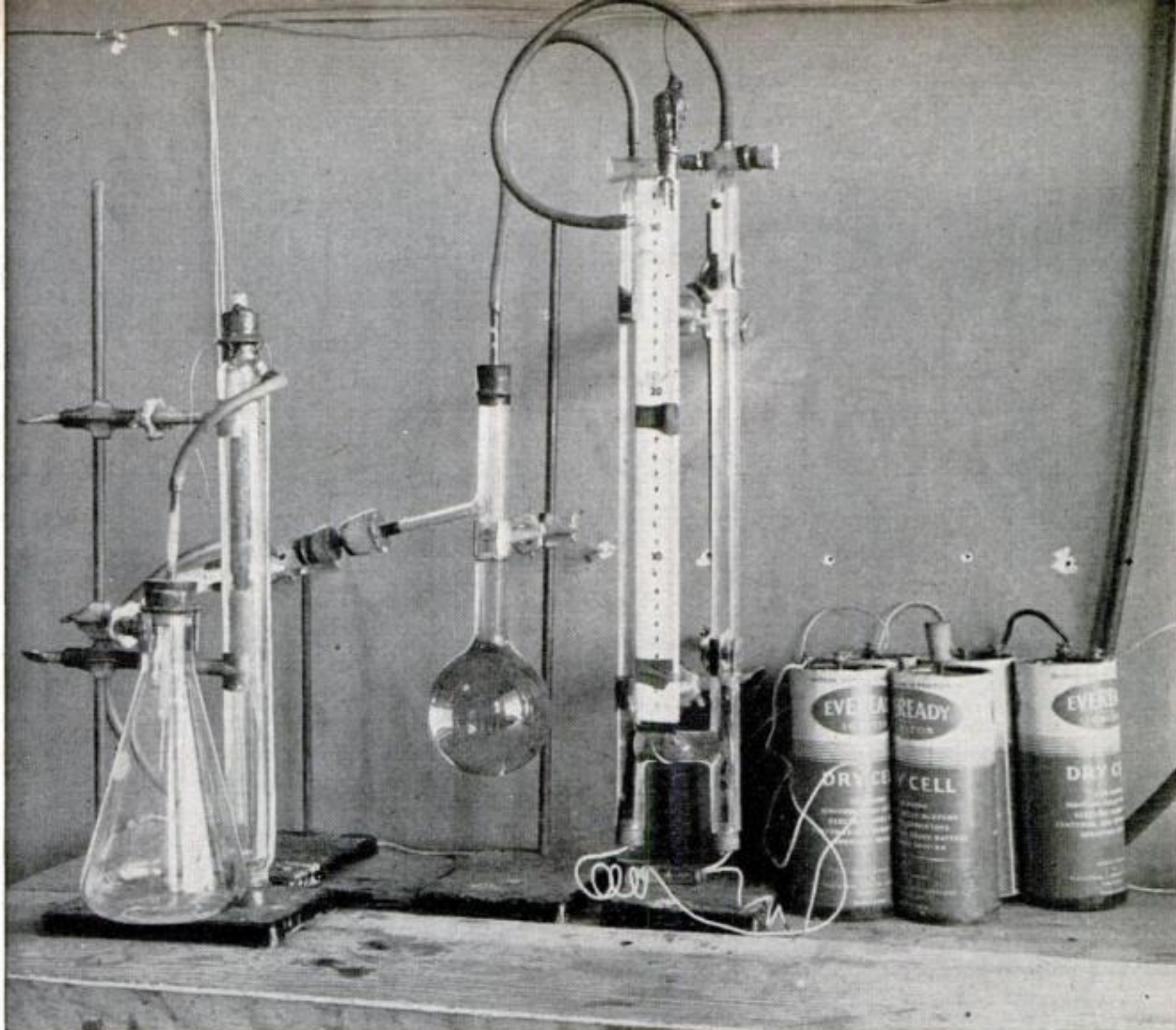
Building such an atom-smasher, however, is much more of a trick than describing one. The El Cerrito boys had seen Dr. Lawrence's big cyclotron, and knew what it did, but they started to build one without any detailed plans for the many intricate parts that constitute such a machine. "We knew,"

Siegel told *Popular Science Monthly*, "we'd need a magnet, an acceleration chamber, and a high vacuum." Under his direction, they studied all the literature available, worked day and night, telephoned to friends for advice when they were stuck, and built their baby cyclotron in a record time of only three months.

El Cerrito's shops could not handle the big piece of soft steel chosen for the magnet, so they went to the Oakland Central Trade School for help. There the chunks were ground down and welded into a double yoke weighing half a ton. Winding the coils was the toughest part of the El Cerrito boys' work. For a week, they stood at a lathe, winding five miles of 13-gauge wire manually, counting each turn aloud until 6,000 turns had been made. As a result of their painstaking care, the magnet now will lift a two-ton anvil.

To create the necessary vacuum within the acceleration chamber, they use two





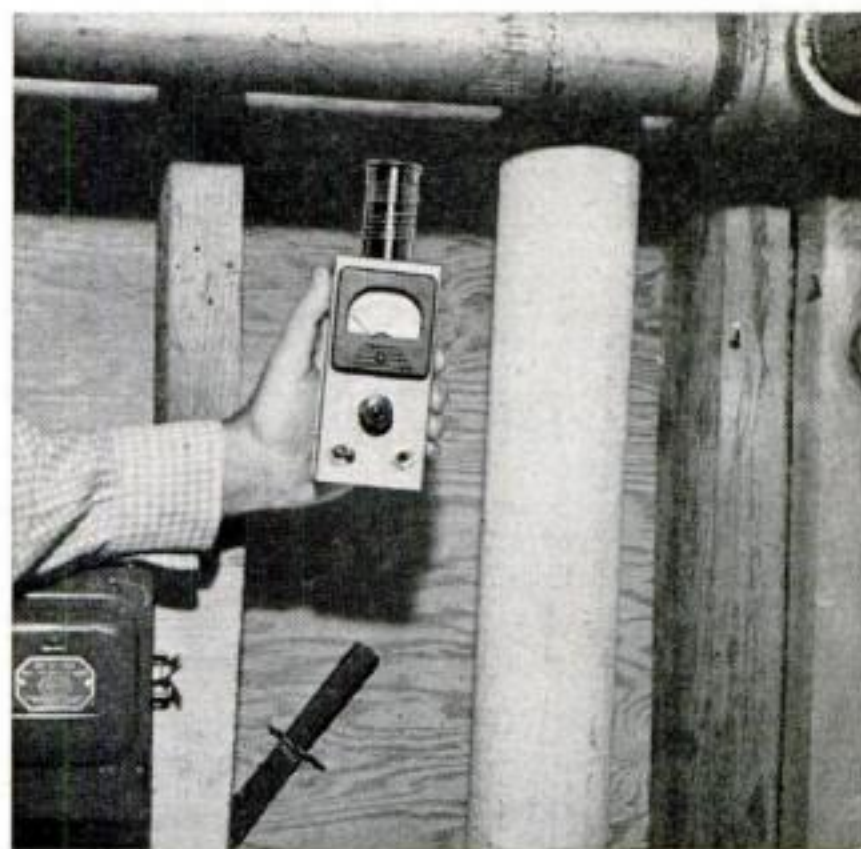
**Proton "bullets,"** nuclei of hydrogen atoms, are produced in this generator, which breaks water down into its two components. The hydrogen is passed through an electrically heated

palladium valve, at the top of the tube at the left, and delivered to the cyclotron chamber. There electrons are knocked off, leaving the proton nuclei to bombard the target.

pumps. The first, or "roughing," pump is an ordinary mechanical pump driven by a quarter-horsepower electric motor. The second, which takes over when the first one has completed its work, is an intricate, mercury diffusion pump, built with the help of an expert glass blower at the University of California. Many different combinations of sealers were tried before a way was found to prevent air from leaking in, but Siegel now believes that the apparatus can produce a vacuum equivalent to only a very minute fraction of an atmosphere.

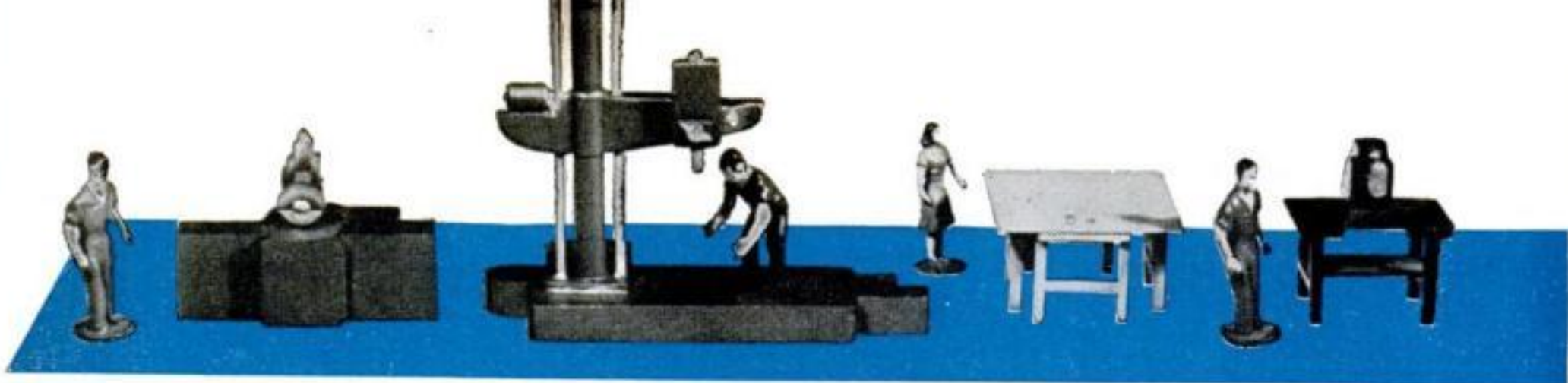
The electrical circuits were also troublesome. They had to be redesigned repeatedly before they functioned properly. Everything in the power system was built over-size purposely, however, because the students hope to build a larger cyclotron chamber later for bigger atom-smashing experiments—and the electrical system they now have will be adequate for their next, bigger cyclotron.

END



**Wave meter** shown above is used to detect possible radio-frequency radiations along pipe lines in the school building. Great care also is taken to prevent any leakages that might interfere with neighborhood radios and bring federal authorities down on the operation.

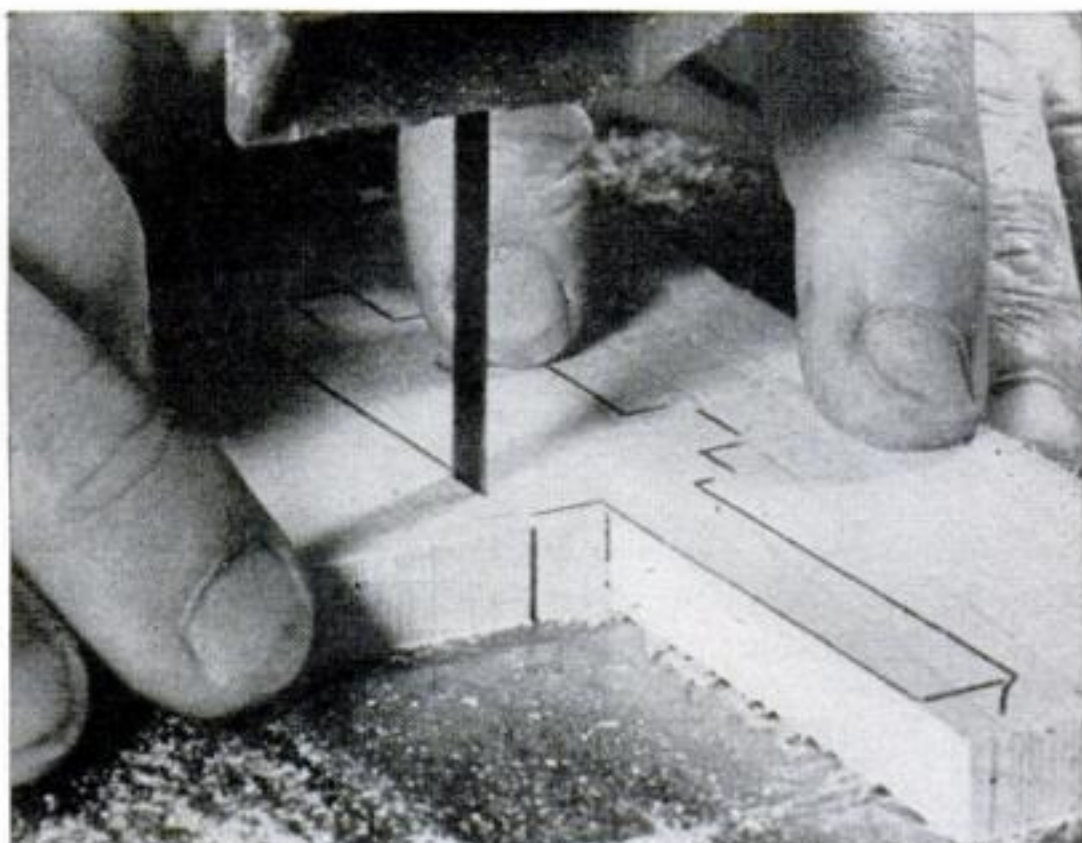




# Big Factories Start Small



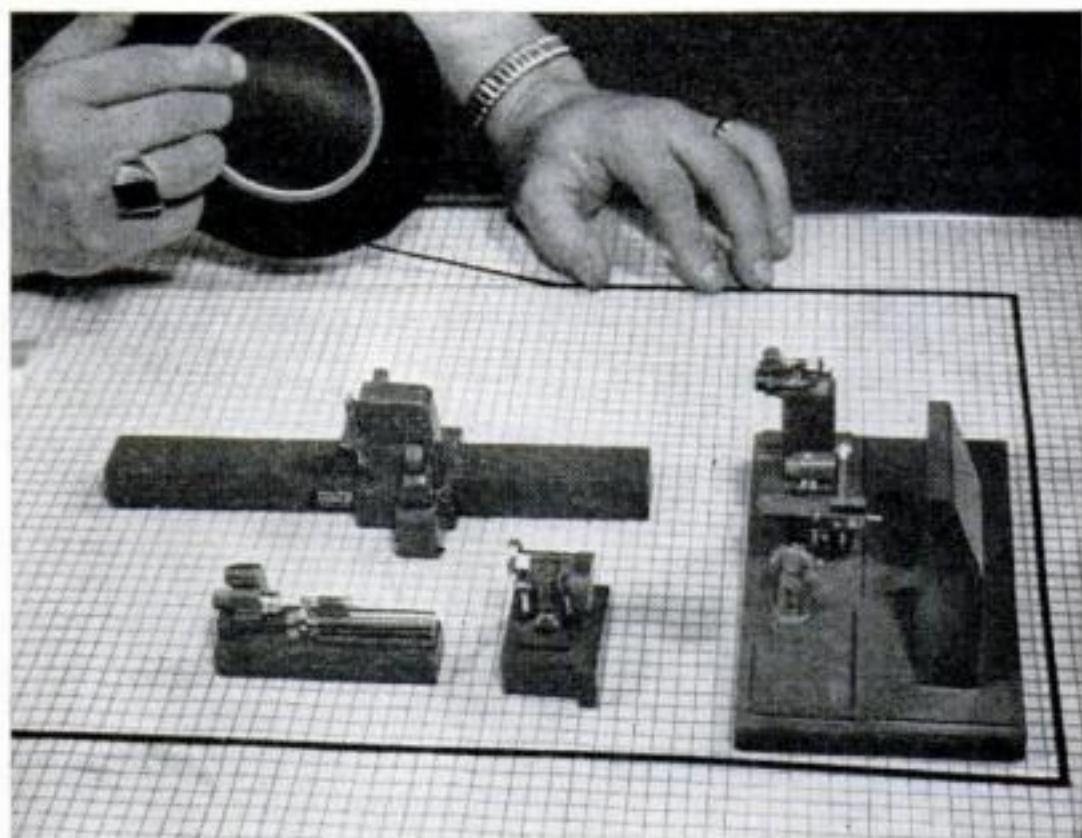
**Template cards**, from which wood bases for the models are cut, are first made from actual blueprints of the machines they are to represent.



**The wood bases**, accurately scaled  $\frac{1}{4}$  inch to the foot, determine models' size and shape, are their most important part. They are cut on band saws.



**Simple, stylized models** of standard machinery, like this miniature turret lathe, are then mounted on the wood bases to identify them.



**Shop plan takes shape** as models are cemented in place on scaled sheets of Lucite. Different-colored tapes mark walls, pipes, and wiring.

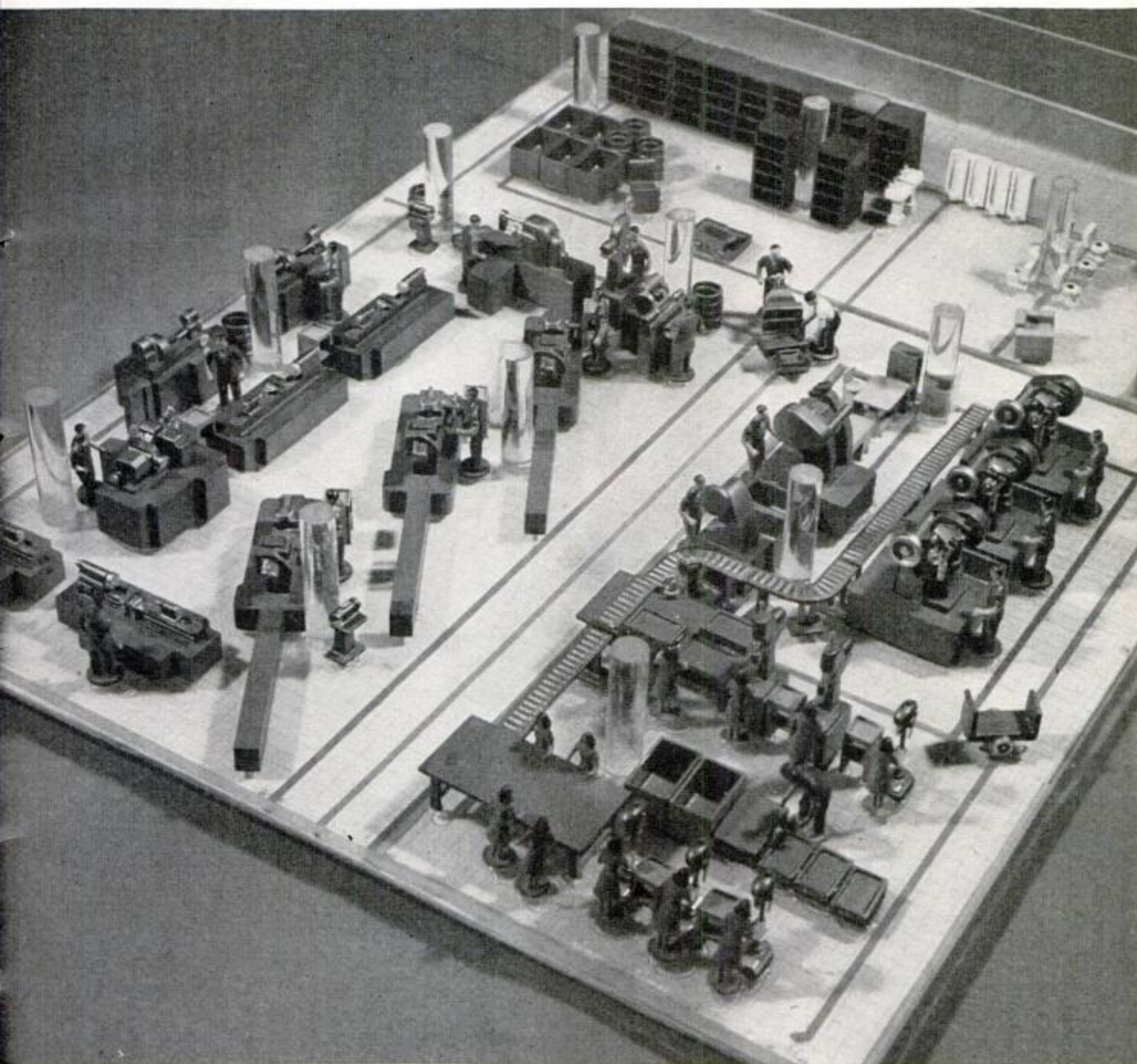




*PSM photos by W. W. Morris*

**W**ANT to build a factory? With these tiny models of machinery, you can set it up, change it around until perfect, and then translate the layout into floor plans—all at a fraction of the cost of ordinary, drawing-board planning methods.

By combining stock parts with custom-tailored bases, the models are both accurate and inexpensive. Made by Visual Production Planning, Inc., they are mounted on rubber stamps. Floor plans are made by inking each piece and stamping it in position.



**Finished factory**, complete with tiny conveyer belt and workers, shows exact arrangement of machinery, rooms, walls, and aisles. At left are

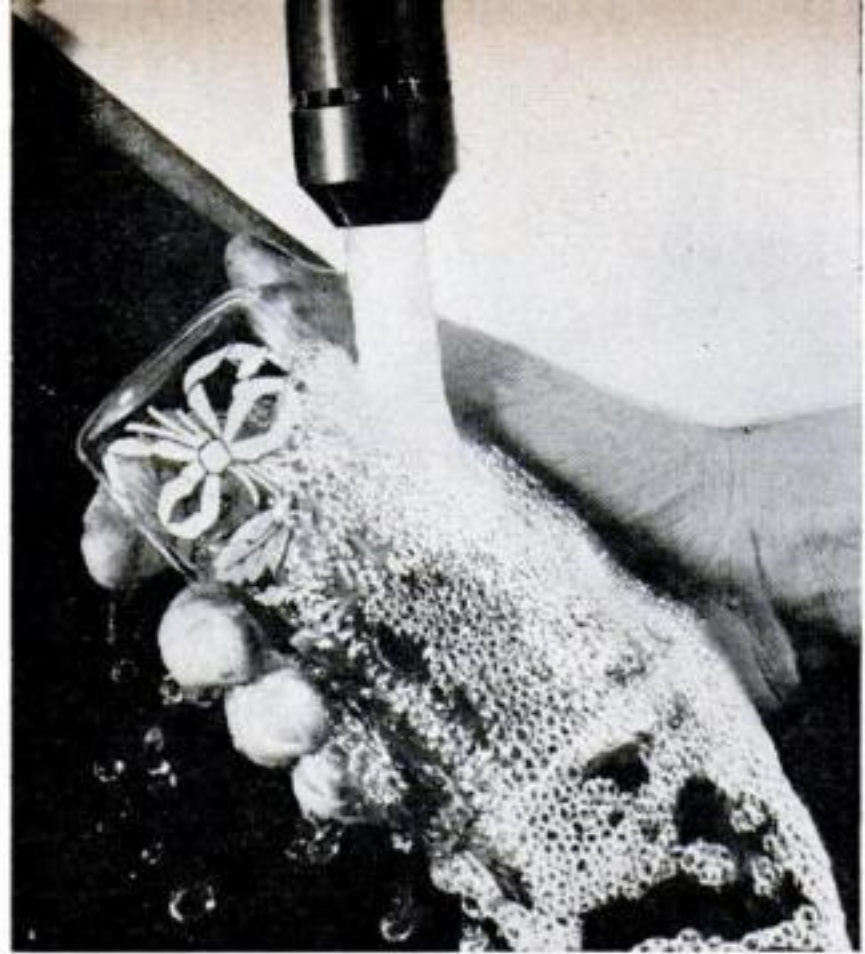
turret and engine lathes; at right, drill and punch presses. At top are stock room and lavatories. Lucite posts represent columns.





## Chemicals Grow Crystals

RESEMBLING a cluster of ice cubes, these are really seeds for telephone crystals. When lowered into a supersaturated solution of EDT—ethylene diamine tartrate—they will grow a crop of synthetic crystals. Developed by Bell engineers, these will replace natural but hard-to-get quartz in long-distance telephone circuits. In a similar project, the Naval Research Laboratories in Washington, D. C., are growing real quartz crystals.



## The Splash Is Gone

AS TAP water passes through this faucet attachment, it is permeated by millions of air bubbles. The result is crystal-clear water that is splashless, softer, and better tasting. Called the Velva-Flo, the device is made by Firestone Industrial Products Co.



## Mirror Detects Flaws

TRACKWALKERS of the Southern Pacific Railroad take no chances on missing any weaknesses in the rails they inspect. The device shown here has a mirror set at an angle at one end, enabling them to inspect the far side of the rails they patrol. Known as the Sands Rail Inspector, it is used in addition to periodic test by detector cars.

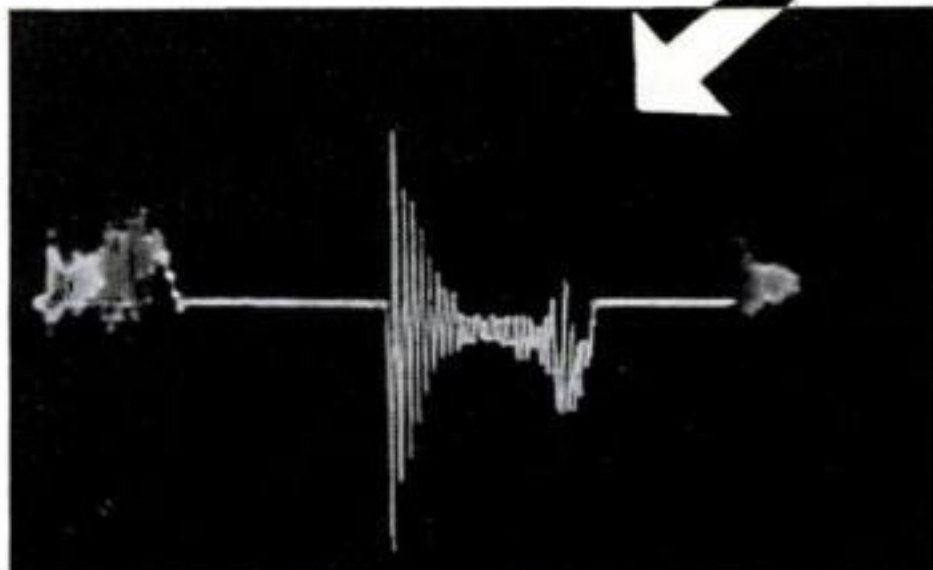
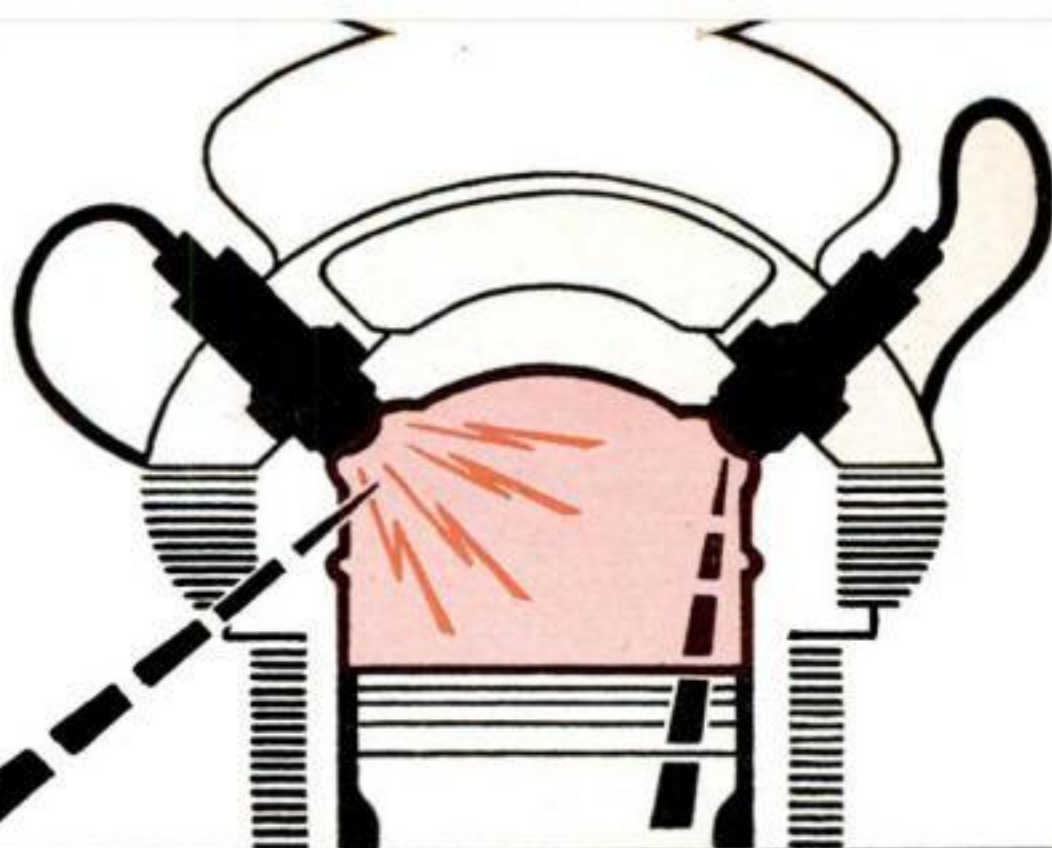


## Dust Can't Penetrate

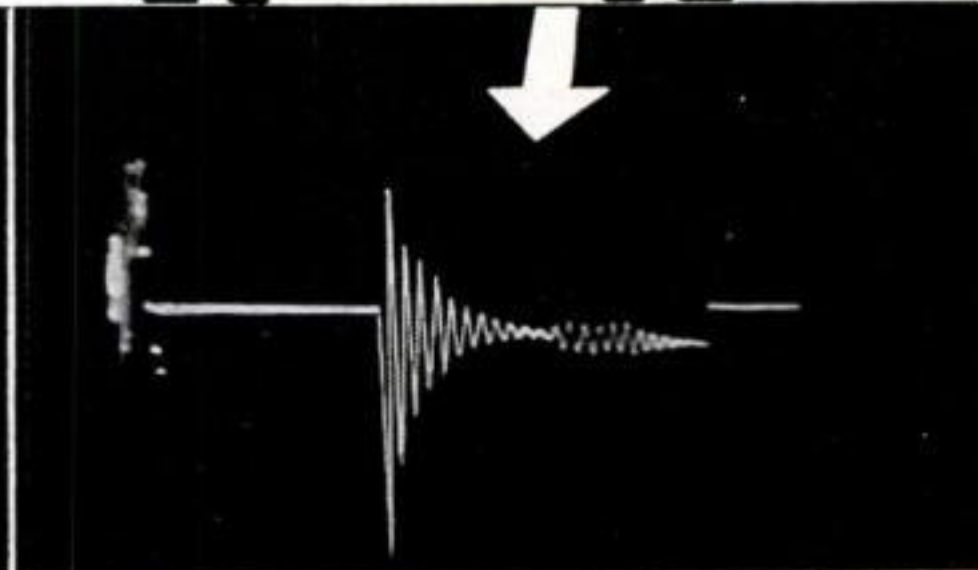
CLEAN areas of this subject's face testify that even carbon black does not penetrate the filter of the American Optical Company's new respirator. Chemical treatment of its fibers makes this filter 40 times more efficient than untreated ones. It will protect workers from poisonous dust particles less than a 24-millionth of an inch in diameter.



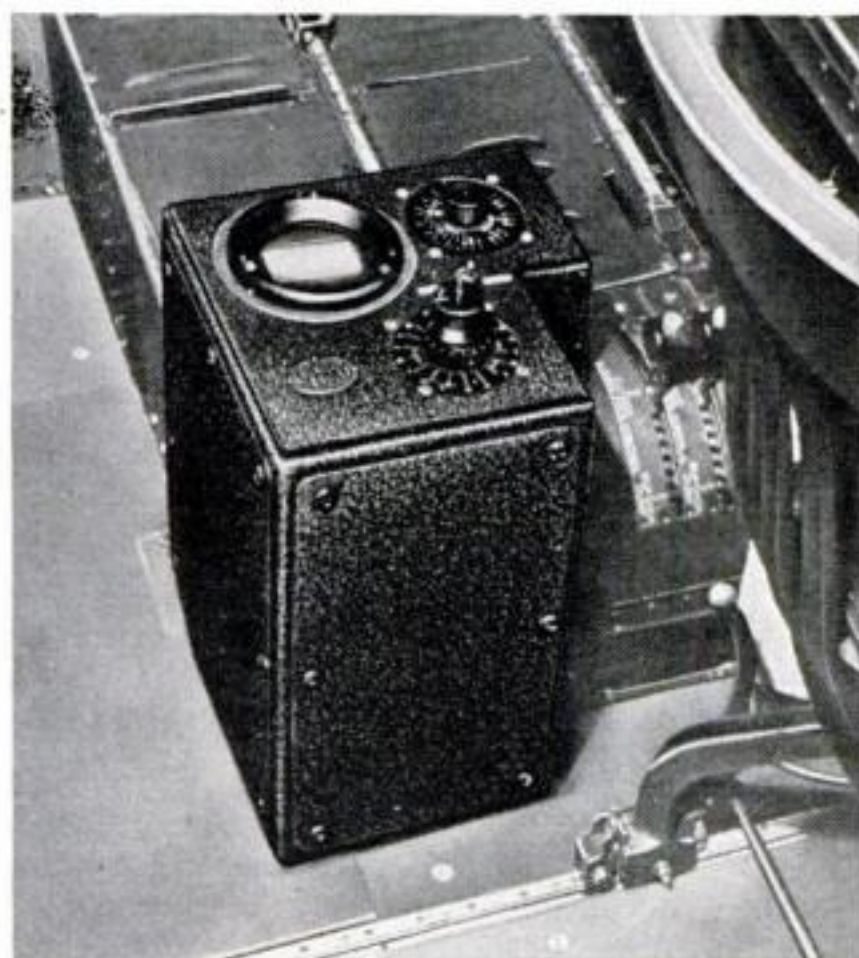
# Analyzer Spots Aircraft-Engine Troubles Aloft



When a spark plug fires normally, this is the pattern that appears on the oscilloscope. It occurs only when breaker points are open; the straight lines show that points are closed.



When a spark plug is fouled, this is the result. Beginning almost normally, pattern changes to a dead short. Patterns for some ailments are similar but easily distinguished.



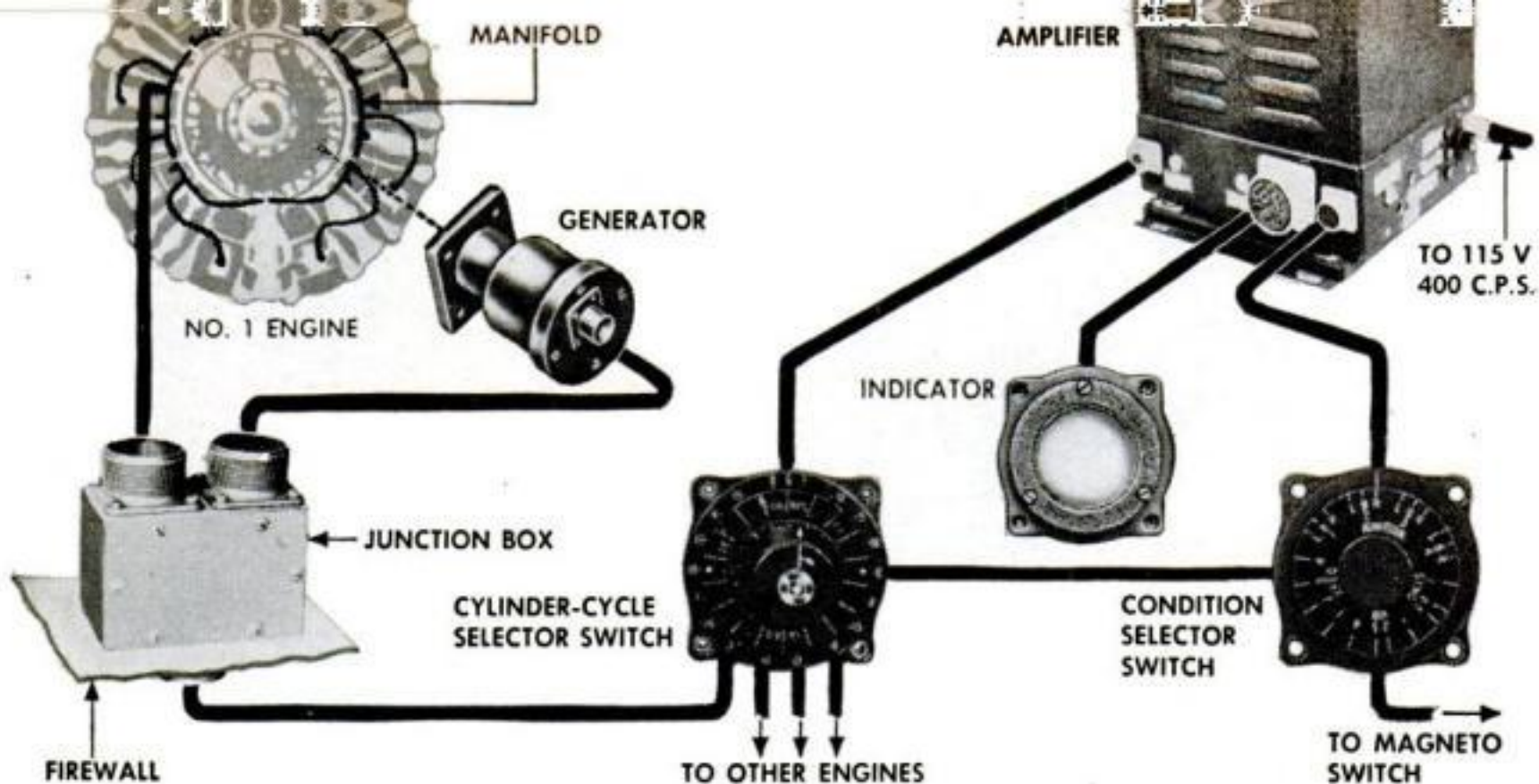
The analyzer itself can be installed as a pedestal unit like the one above, beside the flight engineer's chair in a Constellation, or the indicator and selector switches can be mounted on any panel in the plane. Besides throwing ignition and vibration patterns on the 'scope, switches can produce patterns of synchronization between magnetos and between engines.

**L**IKE a hidden microphone eavesdropping on a secret meeting, a new electronic analyzer for aircraft engines tells just what's happening inside any cylinder of any engine at any time—in flight or on the ground. So accurate that it can spot a single misbehaving spark plug out of the 224 on some big air liners, the analyzer helps avert engine failures aloft and saves valuable hours for ground repair crews by telling them exactly what they're looking for.

The analyzer smells out trouble in two ways. It examines the voltage wave forms in the ignition system for electrical difficulties, and checks on engine vibration (through thumb-sized magnetostriction pickups on each cylinder that translate movement into electrical impulses) for mechanical bugs. In each case, results are shown on an oscilloscope. When operation is normal, the 'scope's shining tracery follows a set pattern; when something goes wrong, the pattern changes—and even minor troubles cause distinctive changes.

Selector switches permit examination, electrical or mechanical, of any engine. If

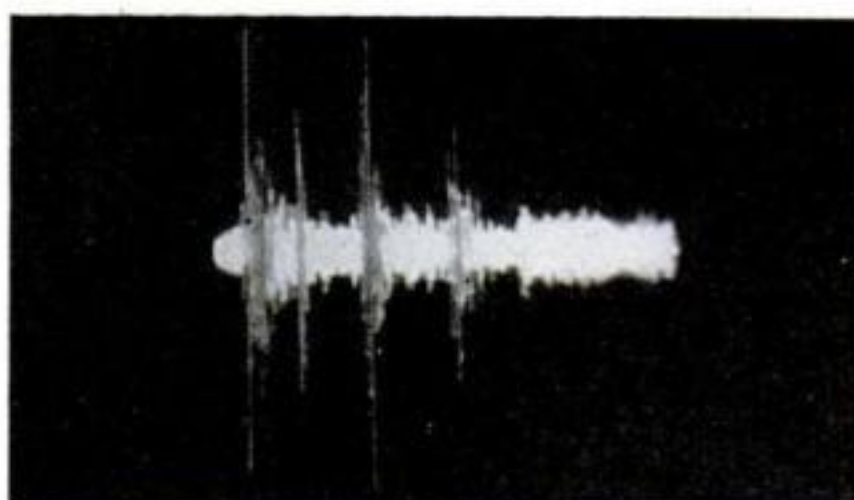




**Diagram shows components for four-engine installation; each engine has separate generator.**

one engine is acting up, the patterns of all its cylinders can be switched in for simultaneous study. Then the pattern for a single cylinder can be selected and stretched out across the 'scope for close analysis. The generators (one to an engine) that power the analyzer are geared so that their voltage always keeps the patterns in step with engine rotation.

The Sperry Gyroscope Co., Pan American Airways, and Wright Aeronautical Corp. shared in development of the analyzer, which has undergone prolonged tests on a Constellation making overseas flights. **END**

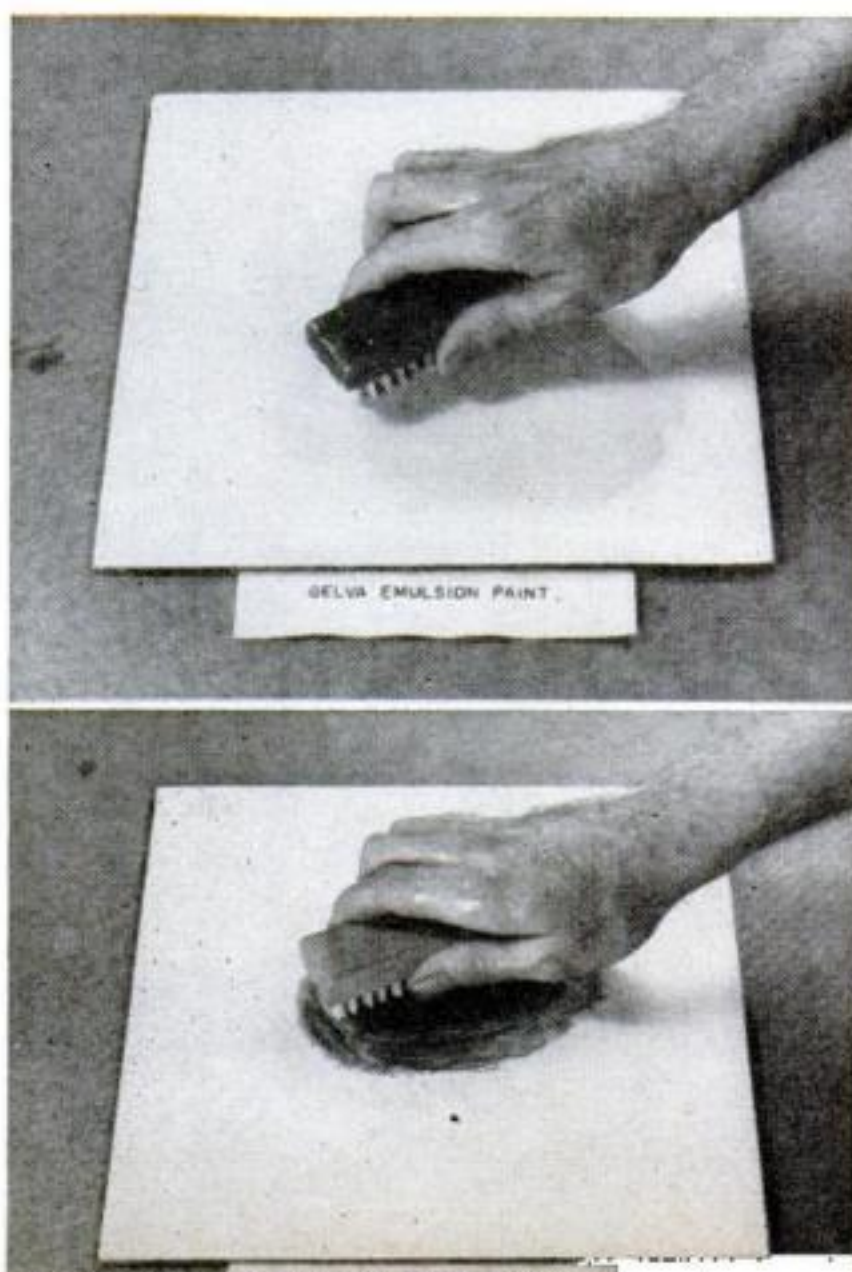


**Normal vibration pattern** shows "pips" of intake, injection, exhaust, and combustion. Other noises show up when anything is wrong, with height and position of pips identifying them.

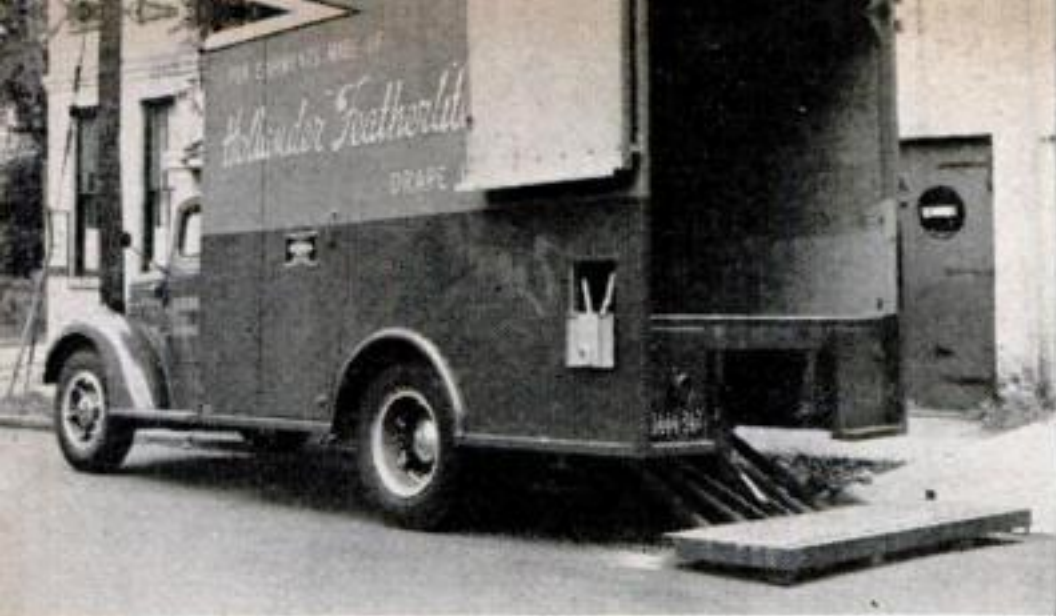
## Quick-Dry Water Paint Is Odorless and Tough

USING a water-dispersed emulsion of synthetic resin instead of the usual drying oils, a new paint that dries in half an hour is said to rival the appearance and durability of oil finishes. Its ability to withstand washing and scrubbing, in contrast to other water-mix paints, is illustrated in the two photographs at the right.

Among other advantages ascribed to the new paint, which is produced by Shawinigan Products Corp., of New York, is the fact that it dries without odor, since the drying process involves merely the evaporation of water to leave a film of pigment and resin. It can be applied either by brush or spray, and while the present product is recommended for interior use, exterior paints of the same type are expected to be put on the market later.







## Easing Trucker's Job

A BOON to drivers, an automatic lift gate installed on rear of this truck saves a lot of back-breaking work. Operated by power take-off from the truck engine, it facilitates the handling of heavy and bulky loads, thus speeding up delivery and pickup schedules. Upper view shows the automatic platform lowered to ground, ready to take on a load. Lower picture shows driver and his helper taking it easy as lift gate does the work.



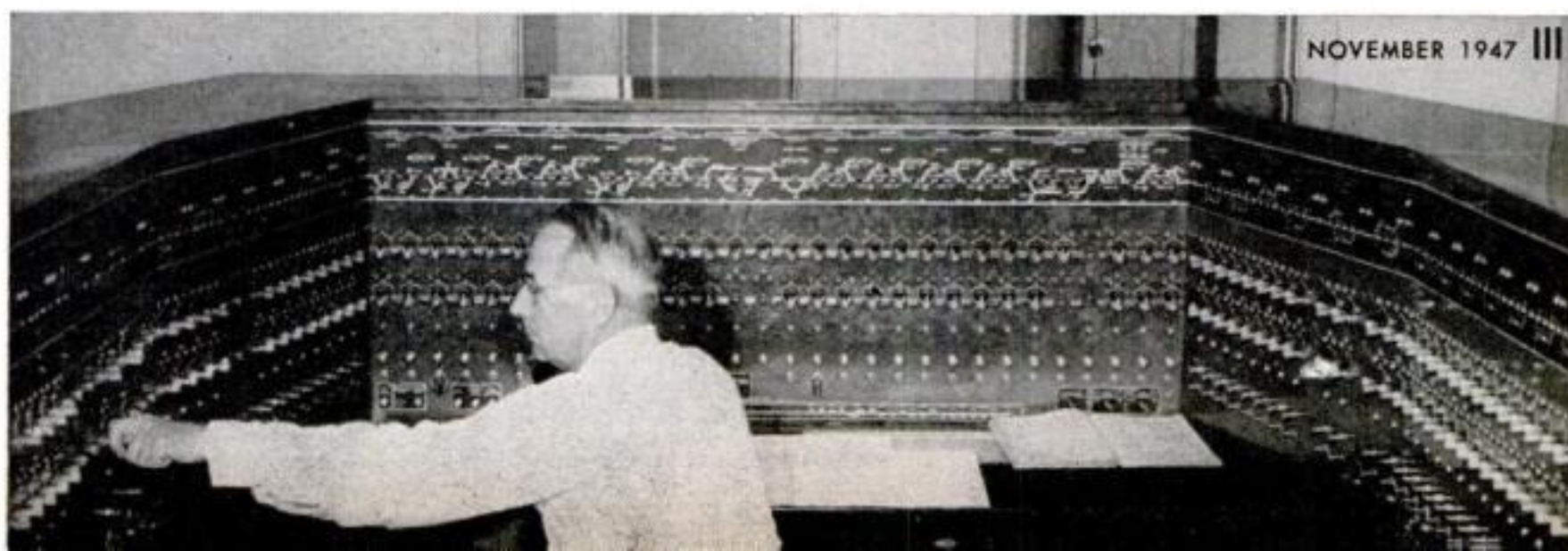
## Climbing to the Rescue

ANOTHER new type of lift is this contraption that climbs up the side of a building to rescue persons trapped by fire. Called a "Mechanical Fly" by its inventor, W. J. Bennett, of Kansas City, Mo., it travels along the ground on rubber-tired wheels. Its 7½-horsepower engine enables it to climb up an "I" beam already installed outside the building as shown here, operating as an outside elevator without cables.

## Remote Control Speeds Rail Traffic

TRAIN operation under written orders is on the way out. Dispatching boards like the one shown below used by the Union Pacific permit centralized control of rail traffic. Through finger-tip manipulation of switches and block signals, dispatchers have continuous control over traffic along hundreds of miles of track. The Union Pacific already has

300 miles of remotely controlled trackage under operation between Daggett, Calif., and Caliente, Nevada. A 329-mile extension into Salt Lake City will make it the largest such system in the world. It is estimated that the smoother flow of traffic by this method increases train speed by more than one third of present rates.



NOVEMBER 1947 III





# Cub Tractor

## —Toy Version



REAR WHEEL



EXHAUST



FOOT PEDAL

REAR-WHEEL PIN



SEAT



REAR MUDGUARD

WHILE production was under way for delivery of the first new Farmall cub tractors to America's farmers, the International Harvester Co. also was tooling up on a pint-size toy version for Junior.

The model, shown here being assembled, is a faithful reproduction of the McCormick-Deering Farmall, scaled down to 1/16 size. It is six inches long by three inches high and can be assembled and knocked down at will. Clips are used for fastenings.

The tractor's interlocking parts are made of Tenite #2, a butyrate plastic. This material was used because, while medium-hard and durable, it is both pliable and flexible. Its natural luster also shows off the familiar Harvester equipment red.

Tires of the small tractor are of real rubber, and on later models they will have treads. Although this first production model of the toy is not mechanized, plans are under way to include this feature in improved versions. Also being developed is a line of quick-change farm implements that can be assembled and attached just like those on the big tractor Papa operates.





# Tune In a Painting

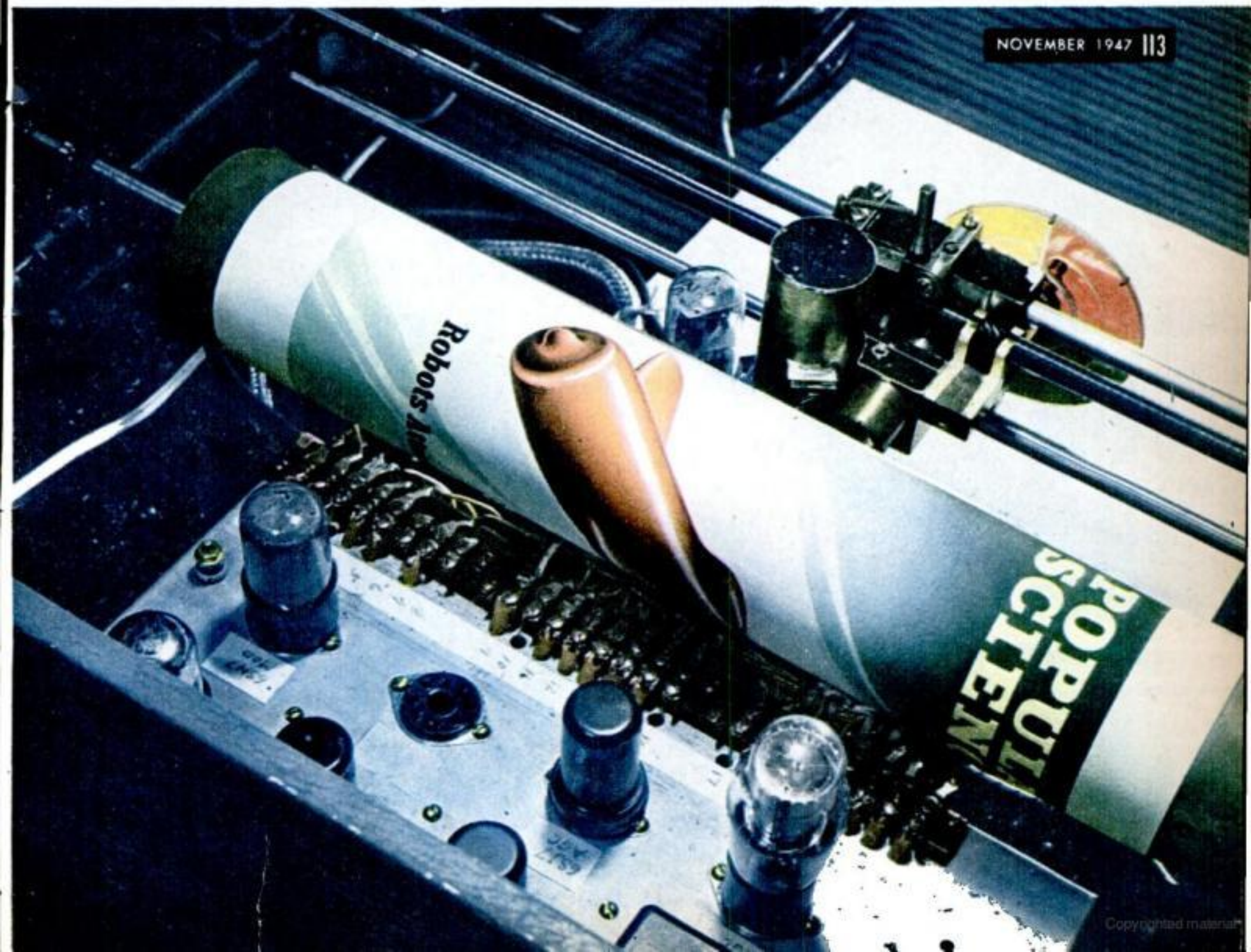
**PSM photos by Hubert Luckett**

Color facsimile equipment is compact and simple. Here is the entire mechanism, with the receiver on the right of the transmitter. At present, the Federal Communications Commission limits facsimile to FM bands.

Transmitter is shown sending PSM's cover painting—the first operation of its kind. After transmission, a Kodachrome of the cover in the receiver was processed with regular color plates for the presses.

**T**AKE a good look at the front cover of this issue of your *Popular Science Monthly*. You are looking at something you have never seen before—a picture that was transmitted by radio in one operation and imprinted on a sheet of ordinary paper.

This is known as color facsimile. It is the product of years of effort to transmit





an image by wire or radio and reproduce it perfectly on ordinary paper at the receiving point. It was developed by Finch Telecommunications, Inc., of Passaic, N. J. Finch labels it "Colorfax."

The first Colorfax machine was built by Dr. LaVerne R. Philpott in his home workshop with "a drill press, a lathe and a couple of screwdrivers." It was demonstrated this fall in the WGHF studio in New York, and a commercial model, which will plug into any FM radio and will retail for about \$150, is being designed now.

As a communications device, Colorfax opens up a whole new world to the home owner and businessman alike. Here are some of the things that can be done with it:

You can listen to a radio lecture on any subject under the sun and look at illustrations accompanying the lecture as they roll out of the facsimile machine—in color. If the lecture is on atomic energy, you can support your understanding of what you hear with colored charts. If it's on automobile repair, you can look at the part

under repair in color. Afterward, if you want to, you can tack the picture up in the garage.

That distinguishes facsimile from television. Television transmits a fleeting record, facsimile a permanent one.

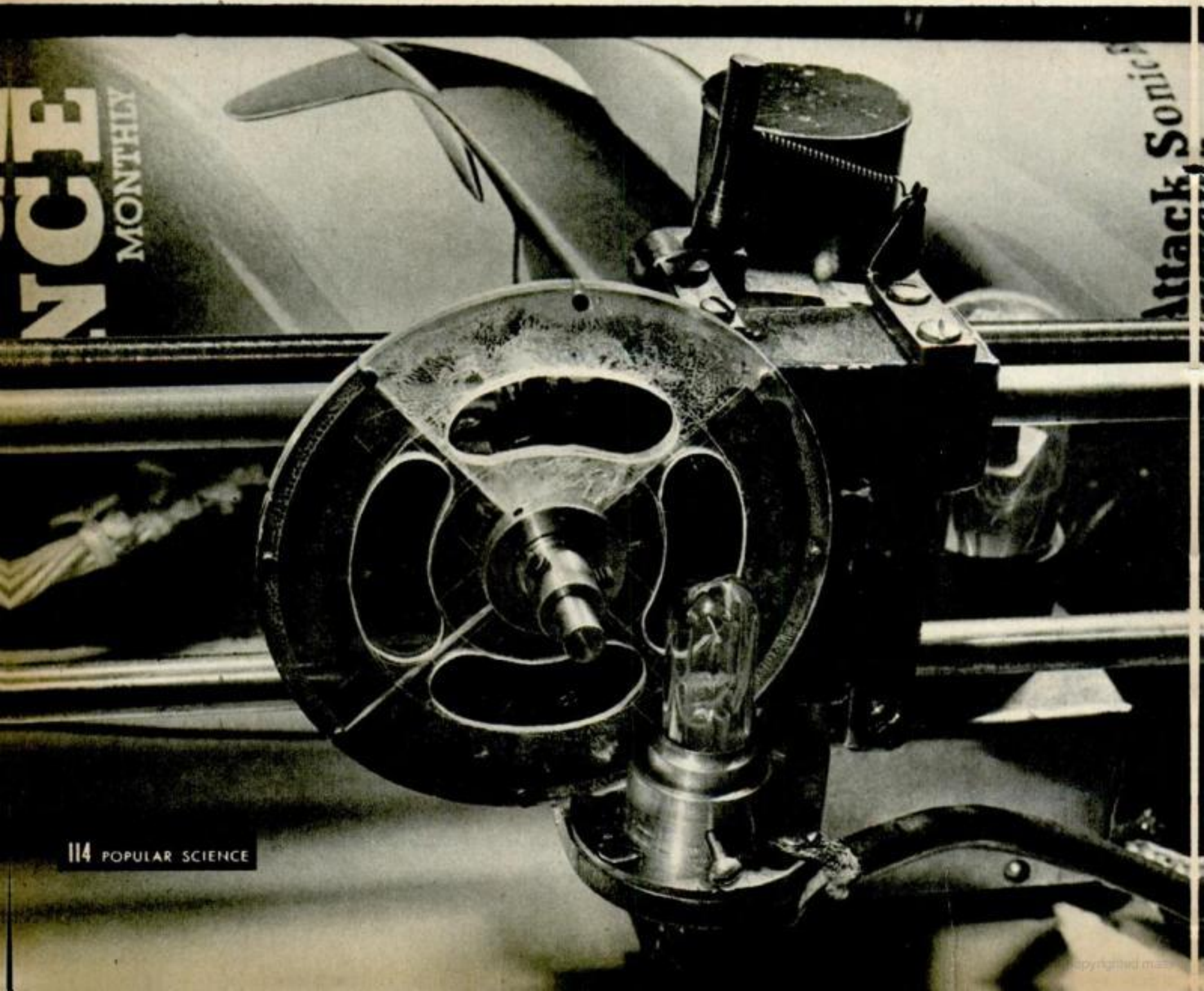
Sunday morning's comics—in color—can be delivered to your children right in your own home by radio, along with news for the grownups that is "printed" as it is on a newspaper page.

Facsimile puts a genie in any man's house, answerable to command. If the whim strikes you, you can squirt the incoming pictures or news onto a wire recording tape or an ordinary phonograph record and then "print" them on paper at your leisure. That's possible because the radioed impulses causing the facsimile receiver to work can be converted into either sound or something to look at. The sound isn't musical. It's like a mouse's squeak intermittently interrupted by a scratching noise.

Facsimile is not new. Color facsimile is brand new. Good black-and-white facsimile

This geared disk, rotating in the transmitter between pin-point light and the painting, filters colors into primary com-

ponents—yellow, red and blue. Black is added to strengthen dark areas. Filtered, colors become degrees of light intensity.





was made possible more than a decade ago when a means was found for converting the tone gradations on a photograph or a printed page into impulses that could be sent by wire or wireless, and then be reconverted on photosensitive or electrosensitive paper into a duplicate of the original. Facsimile was used extensively during the war by the armed services. Even before the war, miniature facsimile newspapers were being broadcast daily by 19 U. S. radio stations to several thousand owners of receiving sets. Today ordinary facsimile transmits news from the United Nations headquarters on Long Island, New York, to a central distributing point. The transmissions are in Chinese, Arabic, Hebrew, Russian and other languages, doing away with the bother of translation.

### *Experiments in Color*

That's fine for black-and-white reproduction. But how about color? Up to a few months ago, for any practical purpose, it was no go. Occasionally a color picture was sent experimentally by radio. This required breaking down the picture into its primary colors, separating each color, transmitting each one separately, and then putting the whole mess together again at the receiving end. It took too long. There was too much chance of "bad registers"—one color overlapping another.

There had to be a simpler way. There was. Capt. W. G. H. Finch, who obtained his first facsimile patent more than 10 years ago, found it. Color facsimile not only is simple, but for the first time in facsimile of any kind it uses plain, ordinary paper—any kind of paper will do. The use of paper that doesn't have to be sensitized and sometimes moistened to boot, or photo-developed after receipt of a transmission, makes operation of the receiver easy.

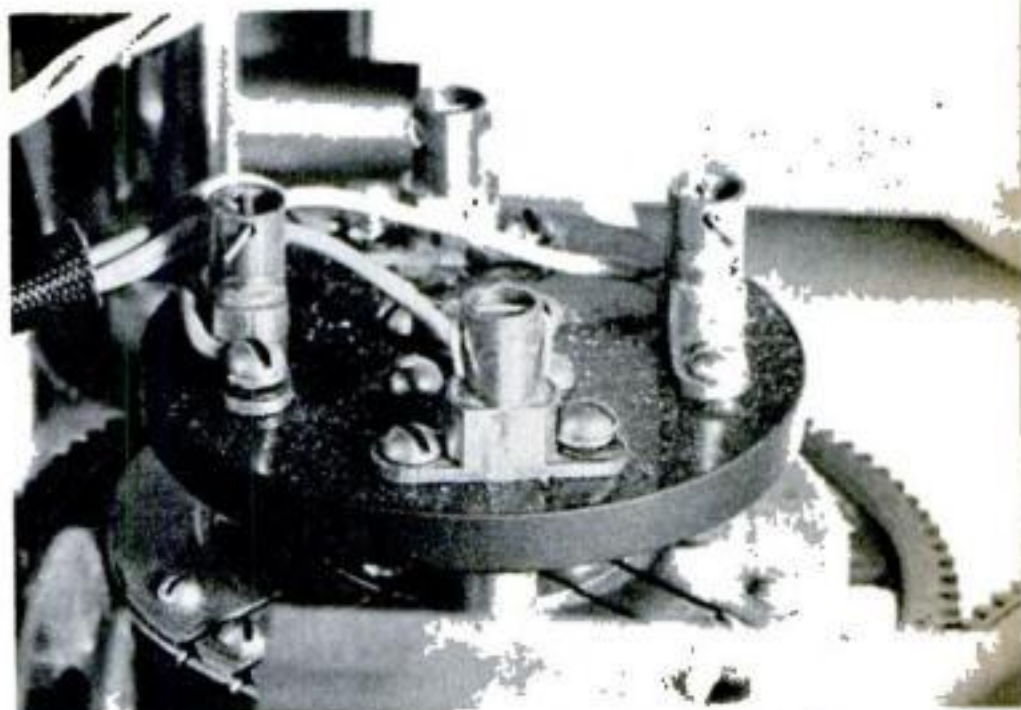
### *Light Scans Subject*

This is the way color facsimile works: The item to be sent, be it picture or words, is fastened to a revolving drum. A pin-point light looks at the item with a fineness of 100 lines to the inch. The light is reflected into a photoelectric cell, which transforms variations in the intensity of the reflected light into electrical energy. A filter disk separates the colors from one another. The light source, photocell and filter are mounted on a single carriage that moves along as the drum rotates. The energy from the photocell is amplified and imposed as modulation on a carrier wave.

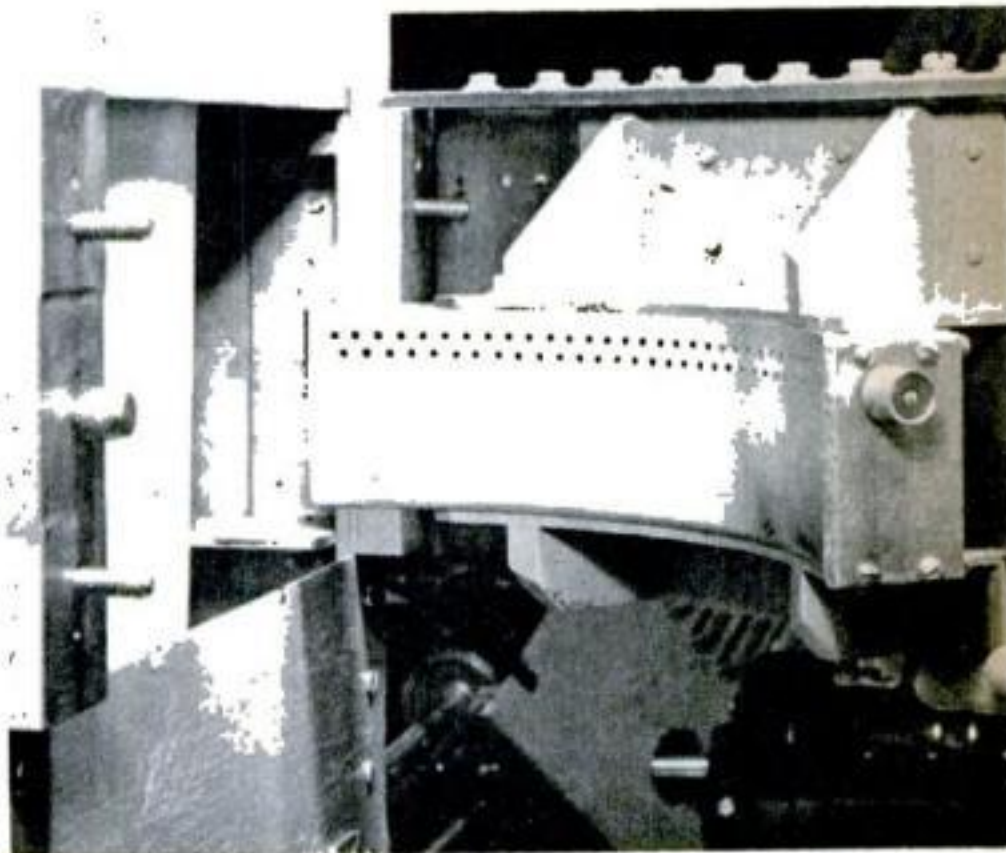
The receiver is something else. Essentially it is a series of mechanical pencils that can be made to mark a line on paper



Co-inventors of Colorfax are W. G. H. Finch (left) and Dr. LaVerne R. Philpott, who also designed the first U. S. Navy radar.

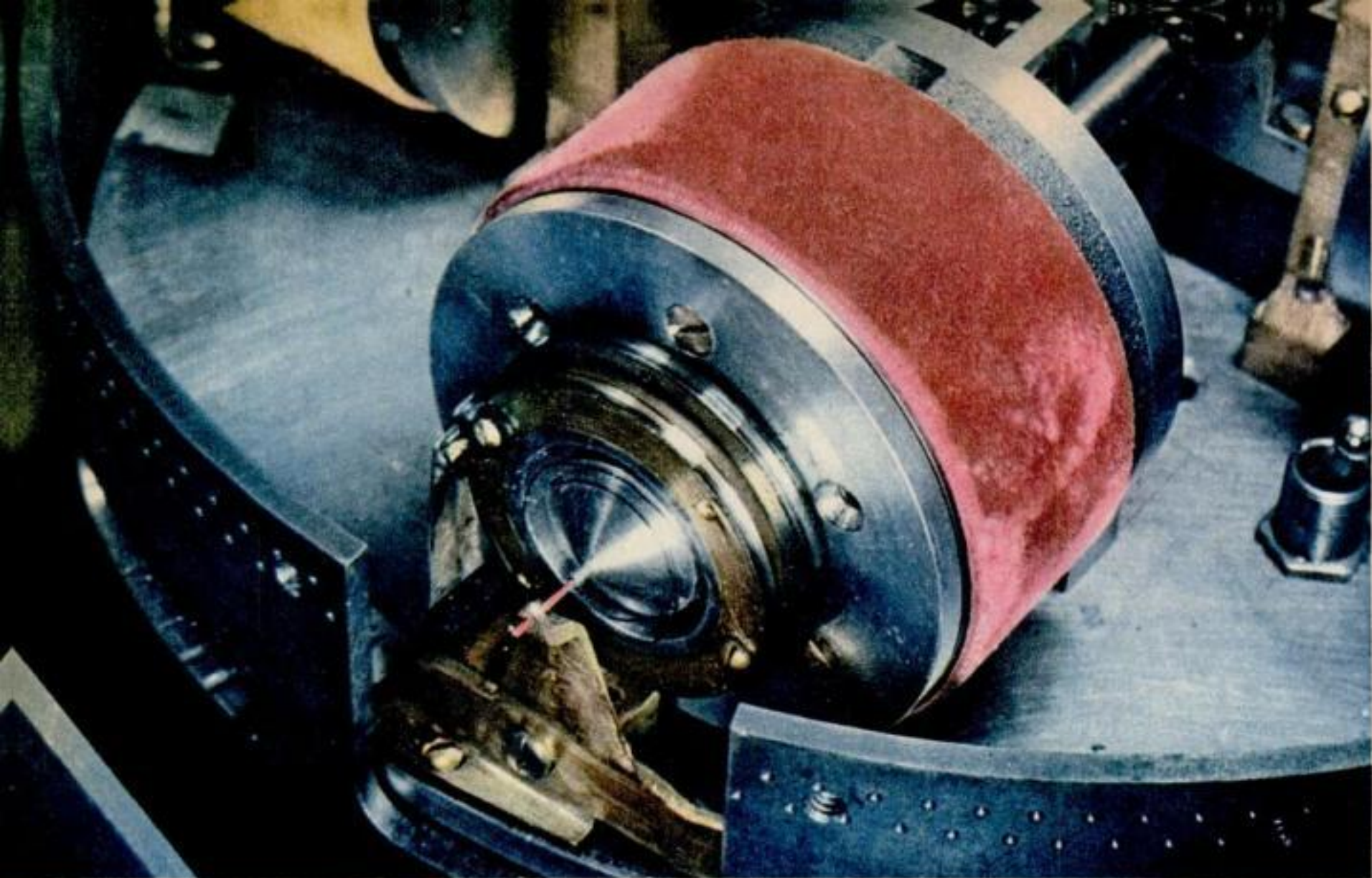


Commutator, geared to receiver's turntable, distributes signals in proper sequence to the colored pencils that trace the design.



Paper support has the same curvature as the rim of the turntable. Tiny holes in the backing plate hold paper in place by vacuum.





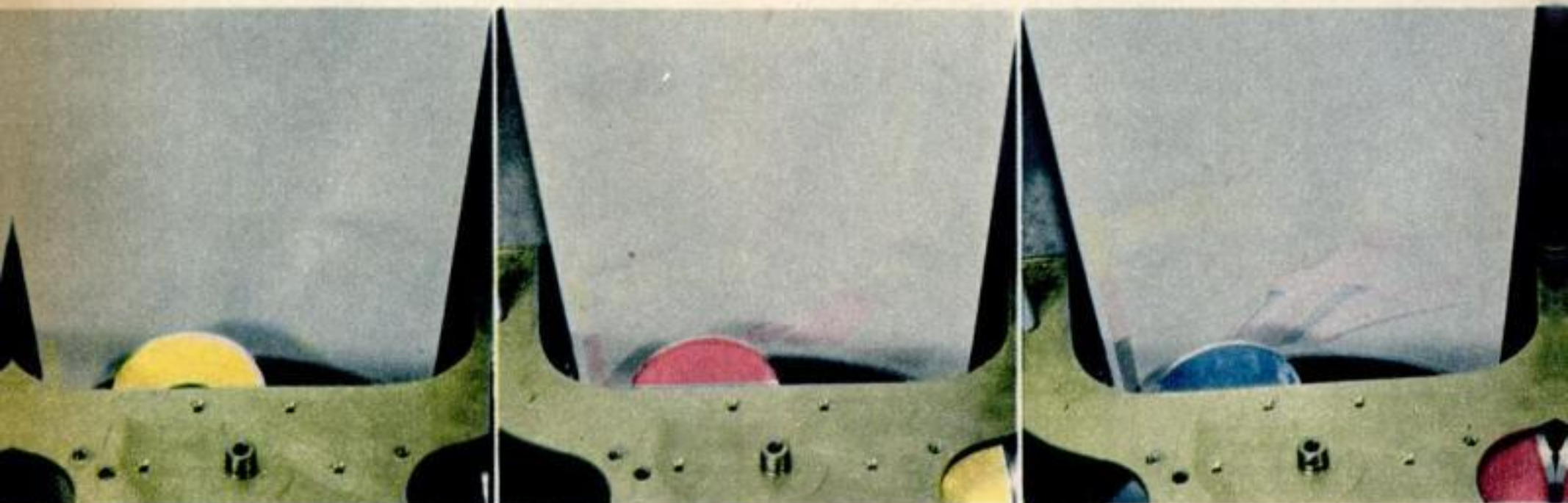
**Colored pencil**, actuated by a voice coil, marks the paper when its turn comes if the incoming signal tells it to. The pencil is

slightly inclined against the surface of the paper, and entire unit rotates. This keeps pencils sharp and insures fine lines.

in accordance with the instructions it gets from the transmitter. When the portion of the item before the scanner in the transmitter is red, the transmitted signal instructs the receiver to make a red mark on the paper. If the signal says blue, the paper gets a dose of blue. Mixed colors are produced by blending the three primary colors, and black is added to improve contrast and strengthen dark areas.

Black-and-white facsimile can be stepped up to a transmission speed of 44 square

inches a minute (equivalent to about 500 words on a printed page), but color facsimile has a limiting factor. Since four pencils have to be given a chance to make a mark on every line, the color transmission is only one-quarter as fast as black-and-white, which requires only one mark per line. Sending a 7- by 10-inch picture in full color, for example, requires about 15 minutes, although this speed is expected to be doubled in the commercial Colorfax model now being designed. **END**

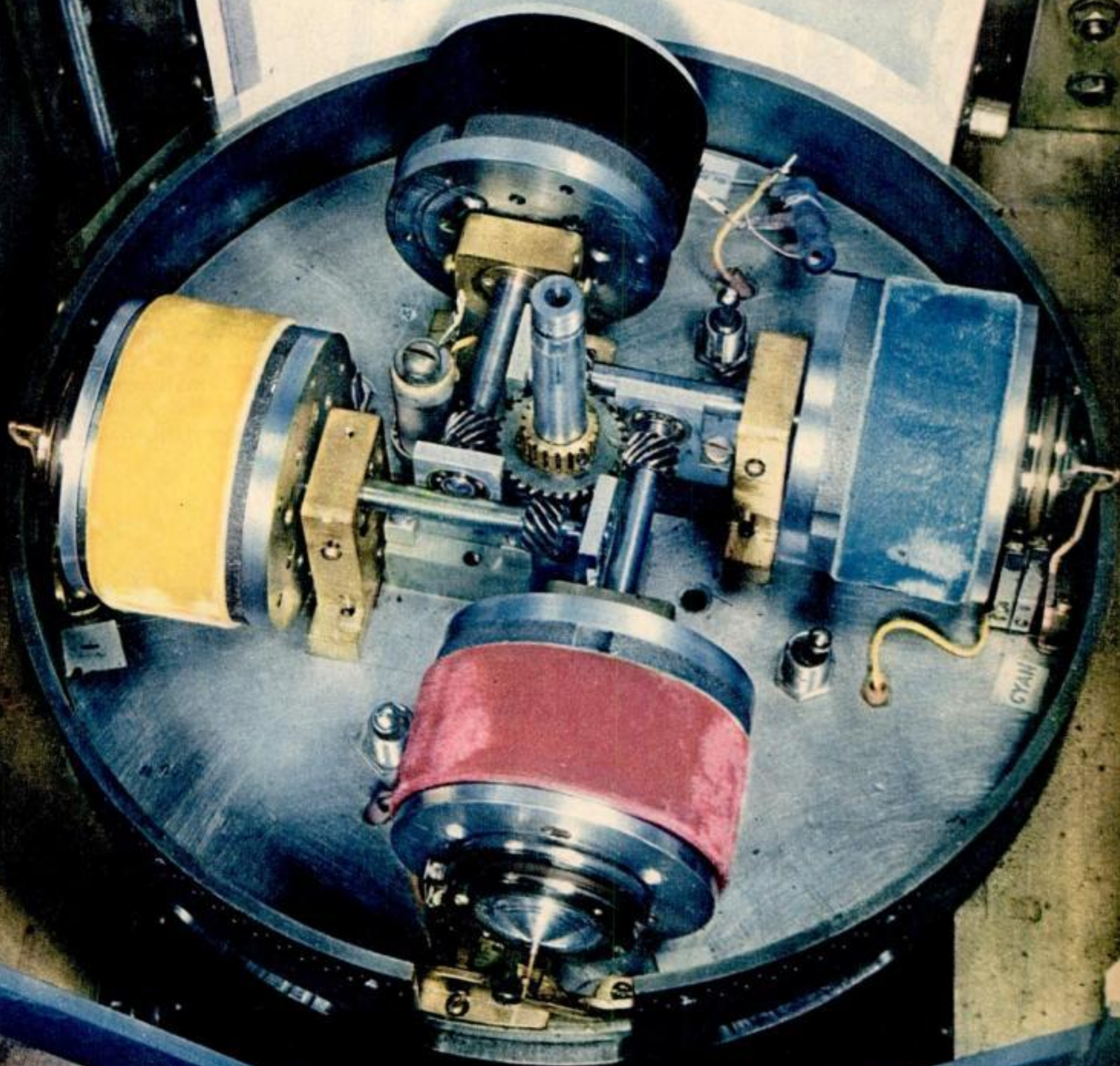


**These separated color effects** show what happens when pencils are put in use one at a time. In actual operation, however, all four colors are applied line by line to

produce the complete picture, as seen above the turntable on the opposite page. With four black pencils, the receiver can handle ordinary black-and-white facsimile.



Robots Attack Sonic Riddles  
P. 82







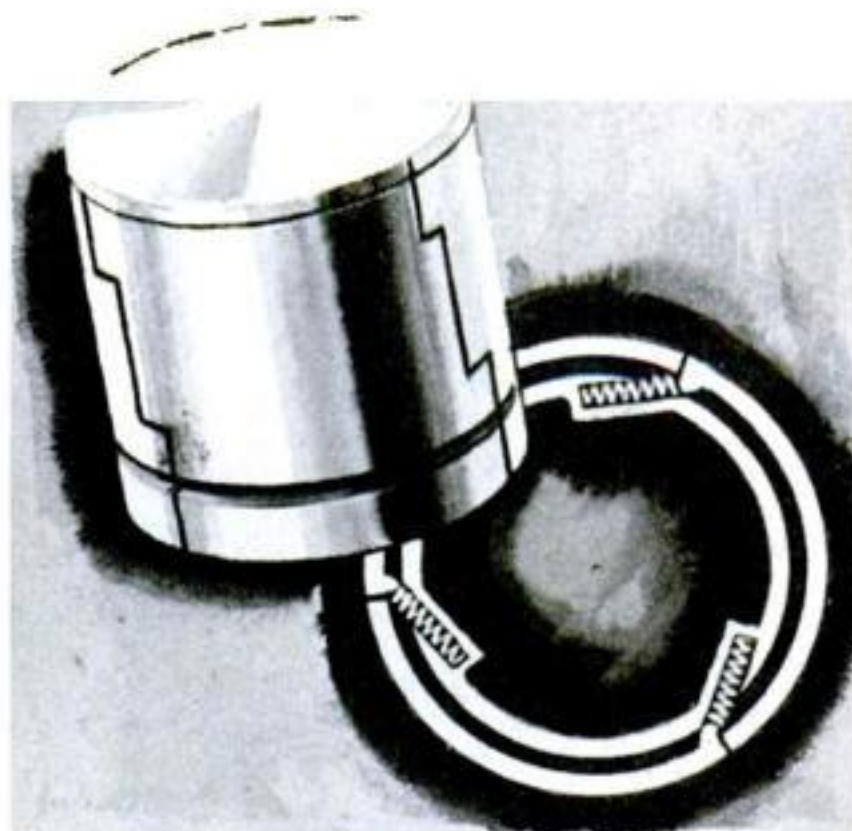
**Rockers Lift Loads.** Curved, rockerlike runners, extending downward from the sides of this novel hand truck, help lift heavy loads by allowing it to tip easily into a vertical position. Patented by John Donald, of Birmingham, England, the truck is



turned up on end to receive the load, then pulled down again to raise it. As it returns to a horizontal position, two small wheels, which extend slightly below the rockers, come in contact with the pavement, and it is ready to be rolled away.

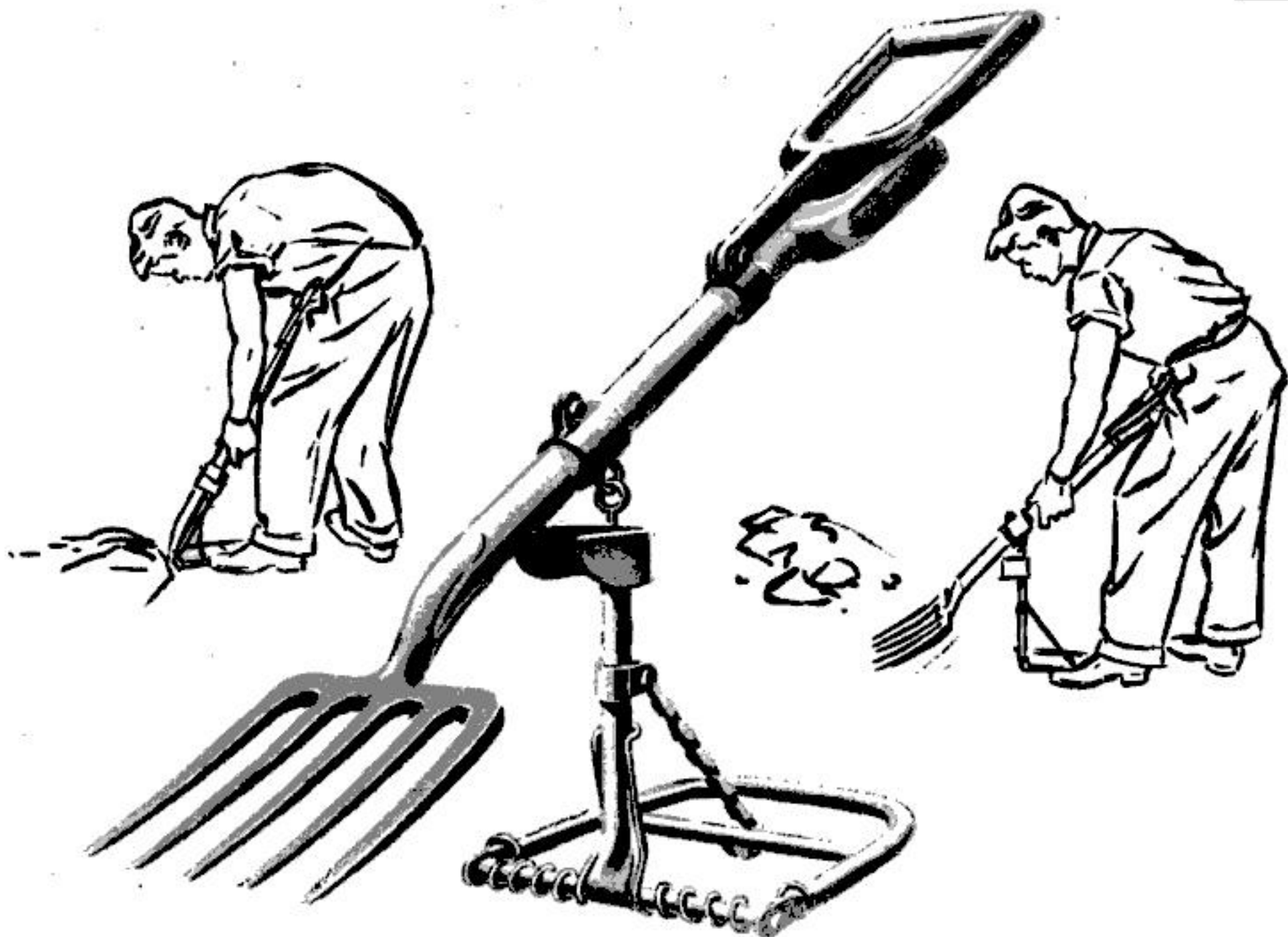


**Hand Phone Packs Dial.** A phone that combines speaking, hearing and dialing systems in a single hand unit is the invention of Knut Blomberg and Ralph Lysell, of Sweden. Lifting it closes the circuit.



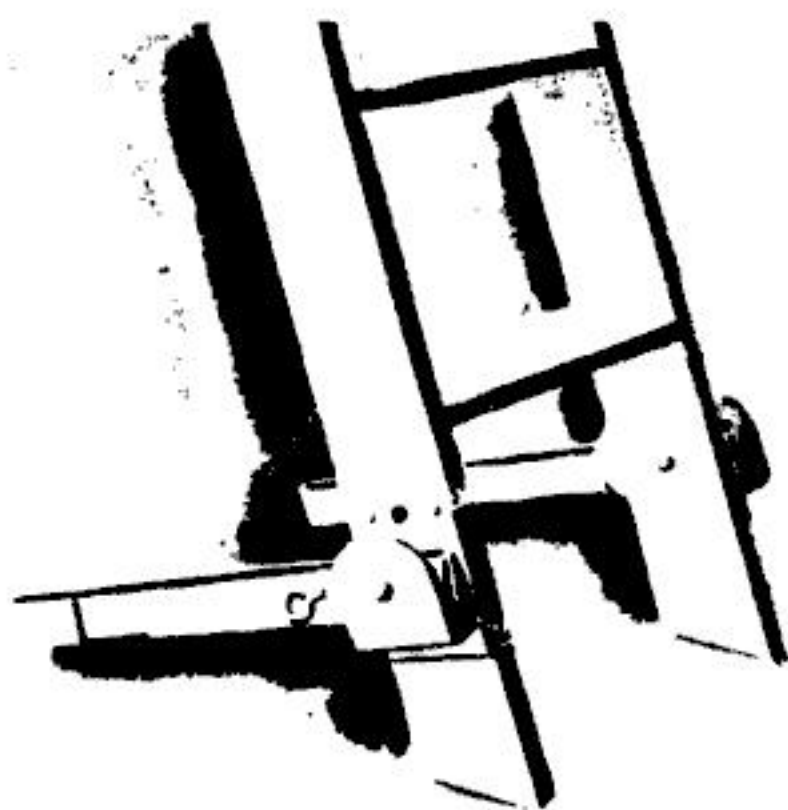
**Piston Needs No Rings.** This self-expanding piston, invented by George P. Floyd, of Akron, O., has a three-part shell, forced outward by three springs, that takes up wear and prevents loss of compression.



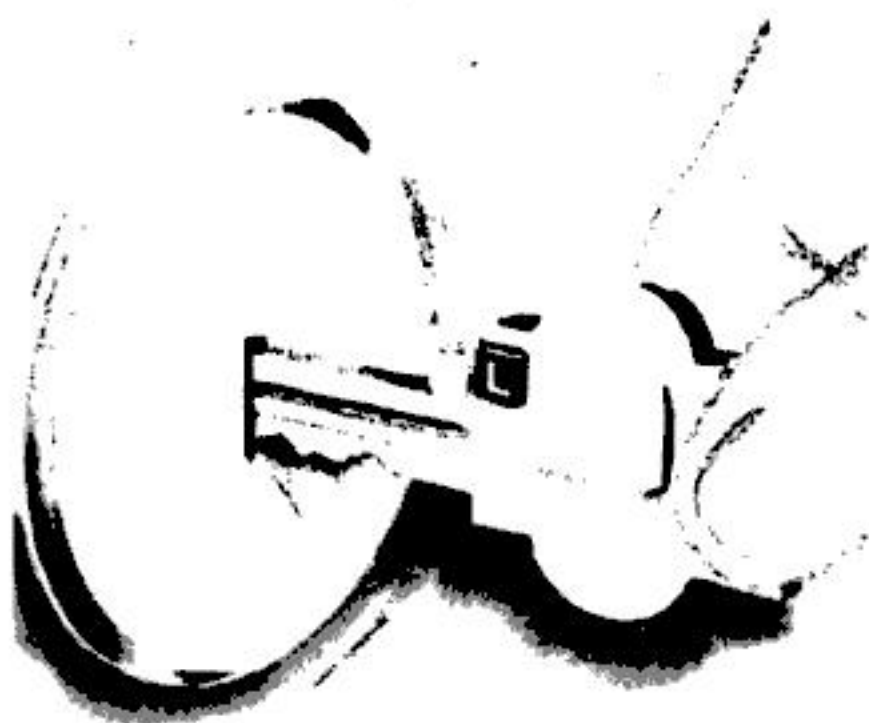


**Pitchfork Pitches Itself.** A self-pitching pitchfork that really lives up to its name is the invention of George H. Gascolgne and Jonas A. Kingston, of England. When driven into the earth and pulled back to loosen it, the fork forces down a spring-

tensioned rod clamped to its handle. When the soil yields, the rod springs back to an upright position, giving the fork an abrupt forward thrust that snaps its load some distance away. An extension handle adapts the device to any ordinary fork or spade.



**Leg Props Brace Ladder.** Your ladder won't slip out from under you with the braces devised by Victor M. Fowler, of Spokane, Wash. Fixed firmly against the ground, they keep the ladder from sliding.



**Key Records Lock Position.** For doors that don't have snap locks, Louis Oberfield, of Brooklyn, has devised a reminder key. It shows an "L" on its side after locking door, an "O" if door is open.





Air view of White Sands shows V-2 assembly tower and slim launching tower for Wac Corporals.

# ***Rockets Outgrow Their Desert Range***

**Research at White Sands is producing missiles too big and too powerful to be fired except with an ocean near by.**

**W**HITE SANDS, the rocket proving ground in New Mexico that has launched dozens of German and American missiles on the trail of the secrets of outer space, is working itself out of a job. From research at this bright desert post are coming new rockets too powerful to be fired within its limited confines.

Flights of V-2s, postwar Wac Corporals and other test rockets are providing data for bigger, longer-range missiles—weapons of tomorrow that may dwarf the Germans' projected A-10, the 110-ton, two-section monster designed to cross the Atlantic for an attack on New York City. Already a number of made-in-USA rockets are in the works: North American Aviation's Nativ, Glenn Martin's Neptune and others. Most, however, are intended purely for experimental use.

When the new, longer-range rockets are ready for flight, they may not start from White Sands, which has an area suitable only for missiles that travel less than 125 miles. The need for larger proving grounds, far from densely settled areas, was vividly

emphasized last May, when a wild V-2 from White Sands crashed near Juarez, Mexico.

Aware of this danger, Army, Navy, and Air Force authorities have already begun surveys of other possible locations for a big rocket test center, and recently recommended El Centro, Calif., a wartime Marine air station near the Mexican border. Other places under consideration are Cape Flattery, the northwestern tip of the United States, and Point Mugu, near Santa Barbara, Calif.

El Centro has the advantage, however, of a range 800 miles down the Gulf of California (and even beyond that nothing but open sea), with land on either side of the gulf for observing stations to track rockets. Test missiles could be followed for hundreds of miles with radar, theodolite and Doppler-effect equipment. The firing range covers sparsely populated sections, but El Centro itself is only 100 miles from San Diego and has good rail connections.

Other countries are also planning long-range rocket testing grounds. Australia has begun work on a \$21,000,000 mammoth shooting gallery extending across 3,000 miles of desert and sea. Rockets are to be launched at Eucla, in Australia's barren western desert, and aimed toward Christmas Island in the Indian Ocean. Tracking stations will be set on land and ships.





Observation blockhouse is at right of towers.

"Gassing up" a V-2 (below) calls for tons of alcohol and liquid oxygen. Then the rocket is ready to take off in a mushrooming blast of fire (right). New missiles now in the works may be too big for White Sands, requiring a longer shooting gallery.





# Six Billion Soft Drinks A Day

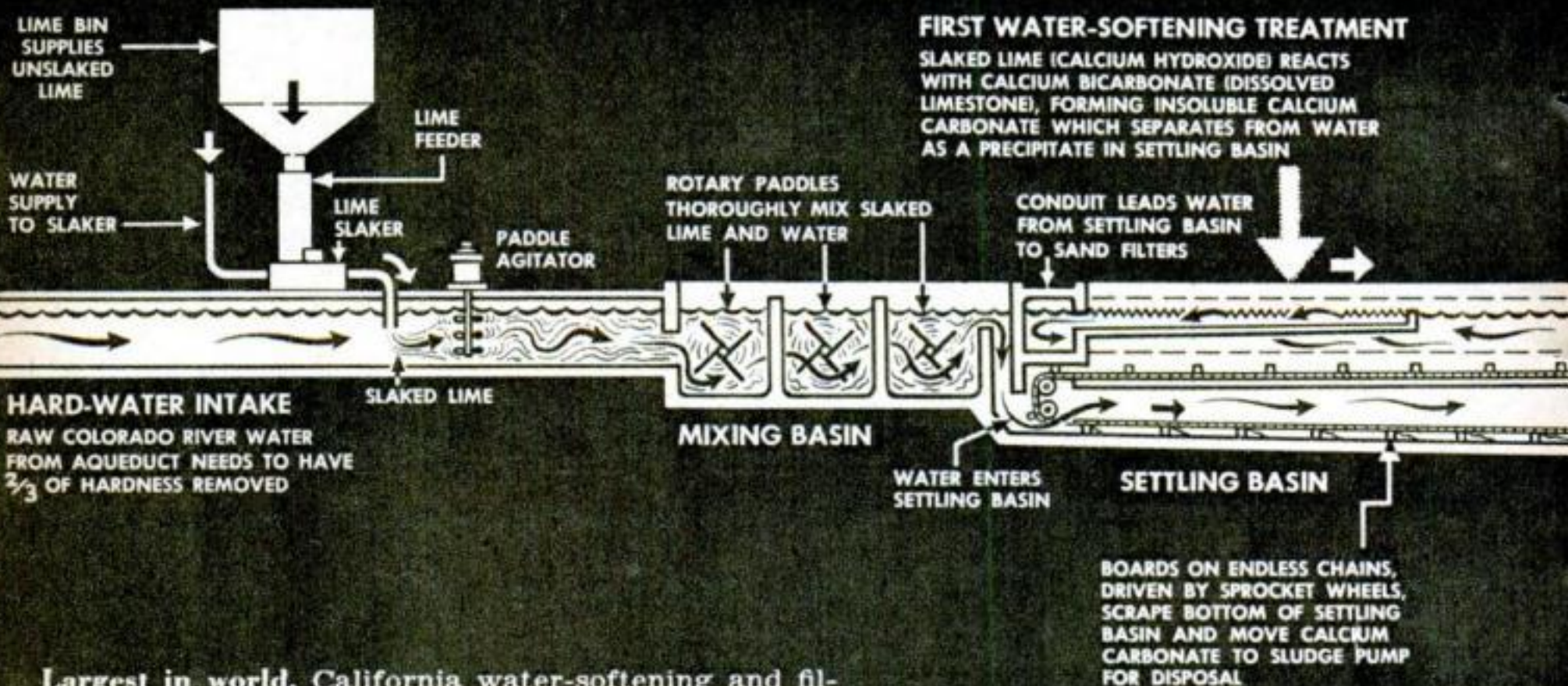
THE world's largest water softening and filtering plant, at La Verne, Calif., turns six billion glassfuls of hard water into soft water daily. How it works illustrates the solution of an outstanding problem of everyday living.

Hard water makes soap curds; it rings the bathtub; it soils laundry; it forms ruinous scale in the boilers of industrial plants—all because it contains dissolved limestone and other "hardness-forming" minerals, such as calcium and magnesium sulphates. Soft water contains only unobjectionable, "non-hardness-forming" minerals—such as sodium chloride (common salt) and sodium sulphate—or none at all.

New Yorkers drink the nation's softest natural water, containing only 30 parts of "hard" minerals per million, but few American cities enjoy soft water until chemicals and settling basins have done their job. Chicago's water is four times harder, and that of Dayton, Ohio, 11 times. Raw Colorado River water flowing to Los Angeles, Calif., contains 360 parts per million, of which two-thirds are removed as shown.



First treatment with slaked lime, stirred into water by three-level mixer spinning 95 times a minute, removes dissolved limestone.

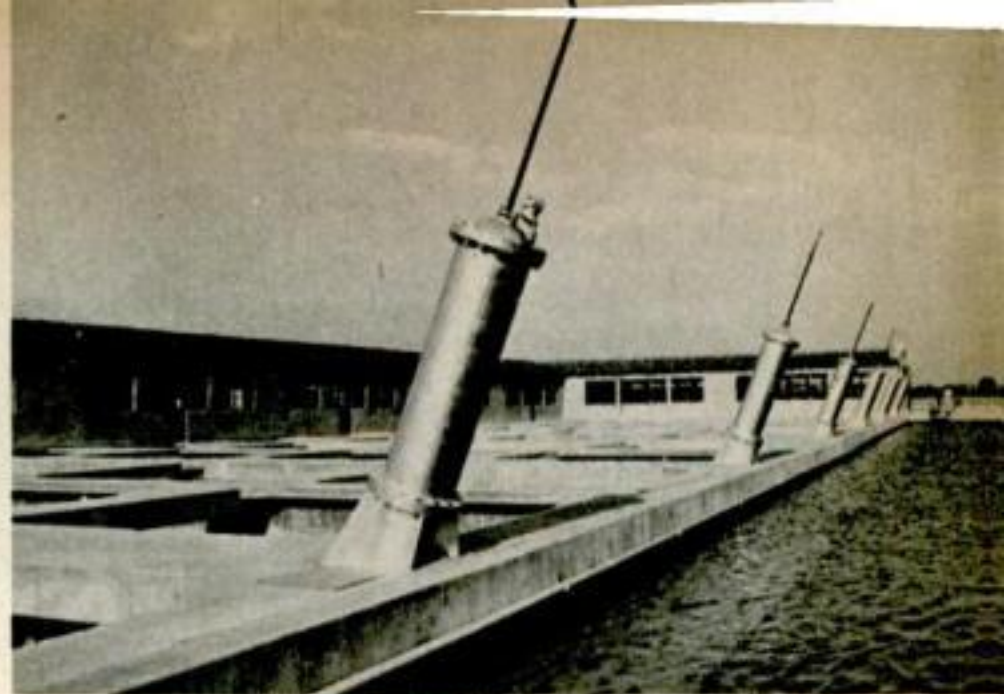


Largest in world, California water-softening and filtering plant illustrates how the process works. The two principal treatments reduce hardness of the water from 360 to about 125 parts per million.





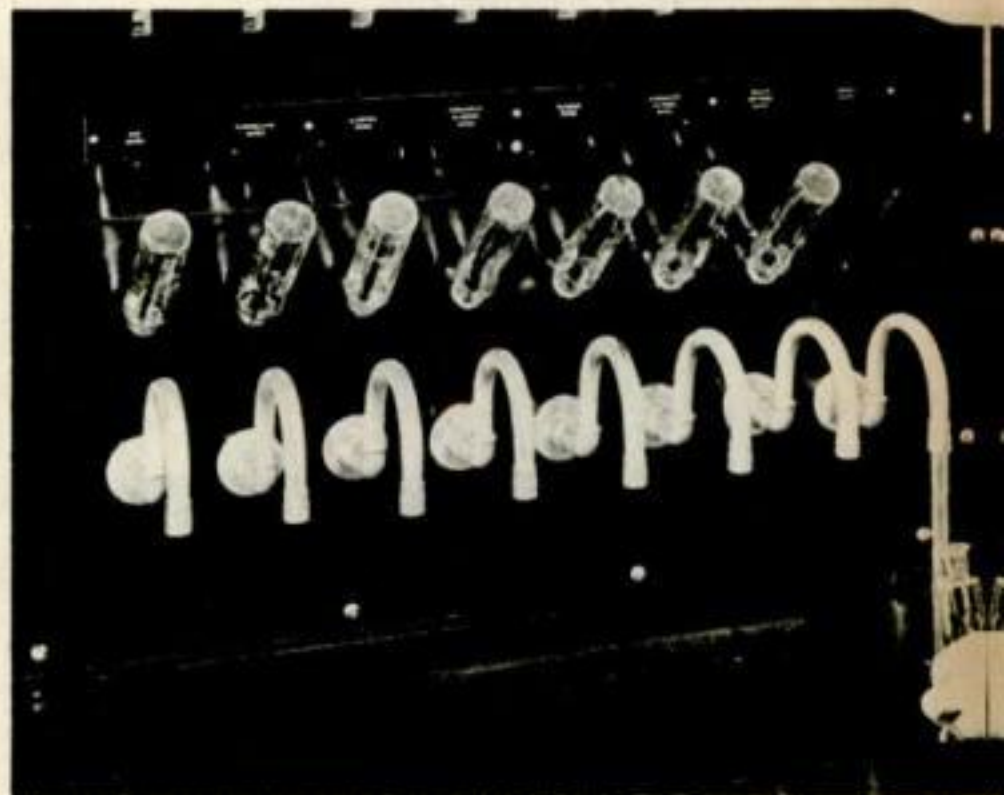
Second treatment with white crystals of artificial zeolite, shown being collected with vacuum tool, takes out remaining minerals



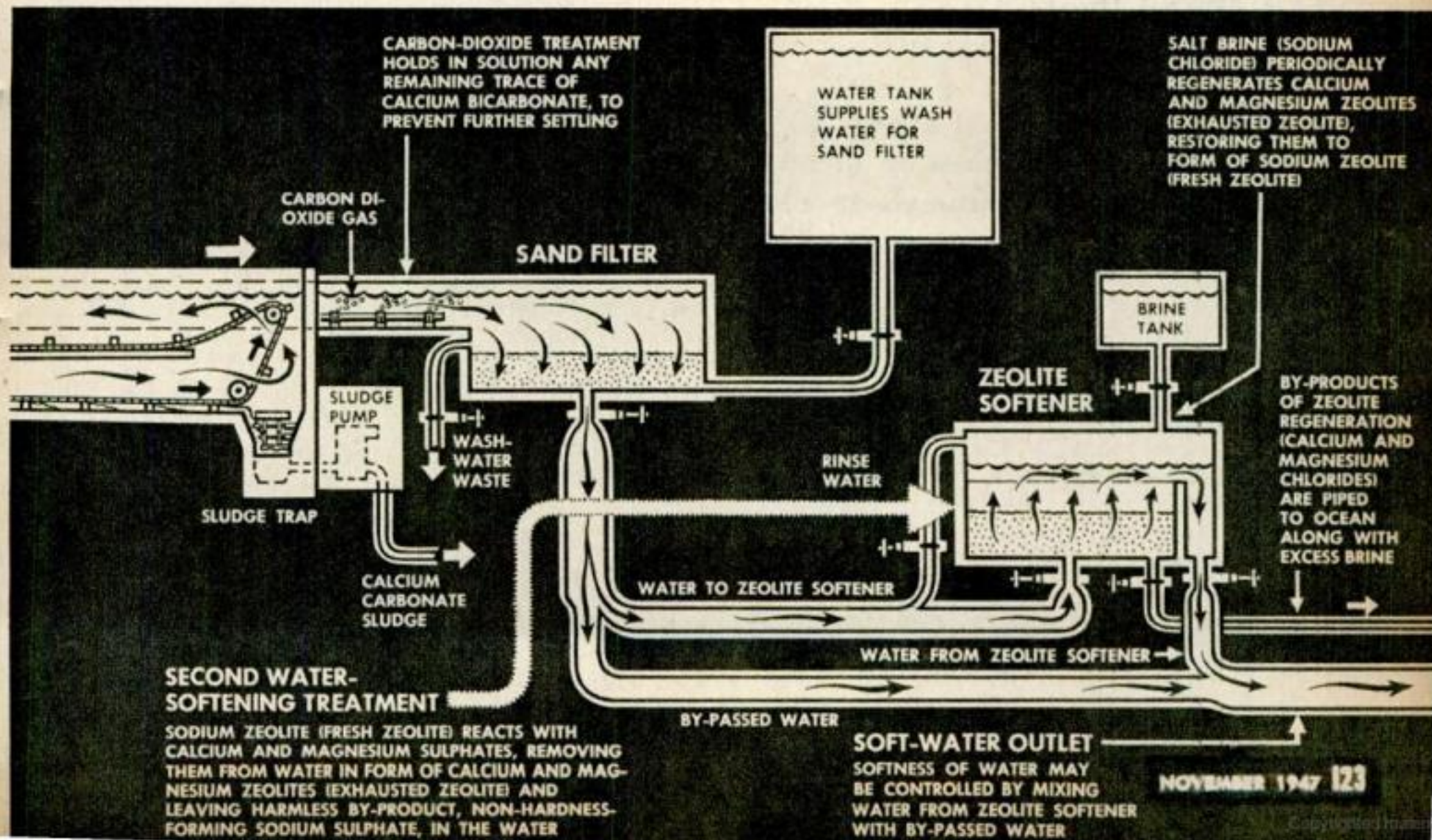
Settling basin holds the water getting lime treatment. Objects like guns are tops of hydraulic gates for water used to wash filters.



Giant scale of the water-softening plant is shown by size of this conduit, which delivers water from settling basin to sand filters.



Samples of water from eight points throughout the plant are withdrawn here for testing. If water is too soft it can corrode pipes.





**Portrait demonstrates** the excellent gradation obtainable, ranging from delicate skin textures to deep shadows.



**A winter landscape, seen edgewise,** shows deep picture penetration in dark parts, shallow in lighter sections.



# Printing Photos Inside Glass

**A sun lamp, an oven and a negative impress permanent pictures on metal particles in Corning's photo-glass.**

**By Alton L. Blakeslee**

**G**LASS with a "memory" is the latest creation of the 6,000-year-old art of glassmaking. This wonder glass captures lifelike pictures, in colors, inside any object into which the glass is fashioned. There they are held forever safe from bending, scratching, fading or weathering—everything but outright breakage. With this glass, photography obtains its missing element—permanence.

Discovered in the laboratories of the Corning Glass Works, the new glass is crystal clear and looks and behaves just

like any other good glass. It can be worked into delicate goblets, or church windows—into any desired thickness or shape.

Whatever its shape, all this glass needs to remember a picture is a photographic negative, ultraviolet light, and heat. The remembering is done by tiny metallic particles, completely invisible even under a high-powered microscope, that are mixed into the glass when it is made.

Once made, the glass must be kept out of sunlight or other ultraviolet sources until it is used, but no other precautions are needed. The process can be carried out in ordinary room light, and it requires no chemicals. The negative is placed against the glass and then exposed for two or three minutes to ultraviolet light from a sun lamp or other strong source. When the negative is removed, the glass to all appearances remains unchanged, still clear and transparent. But when it is placed in an oven or kiln and heated to 1,000° F., the picture quickly begins to appear.

This picture is not just on the surface. It extends inside the glass and may run as much as two inches into it, producing a three-dimensional effect. It will appear in one or a combination of colors—white, purple, orange, ruby, yellow, brown or blue—according to the kind of photo-sensitive glass used.

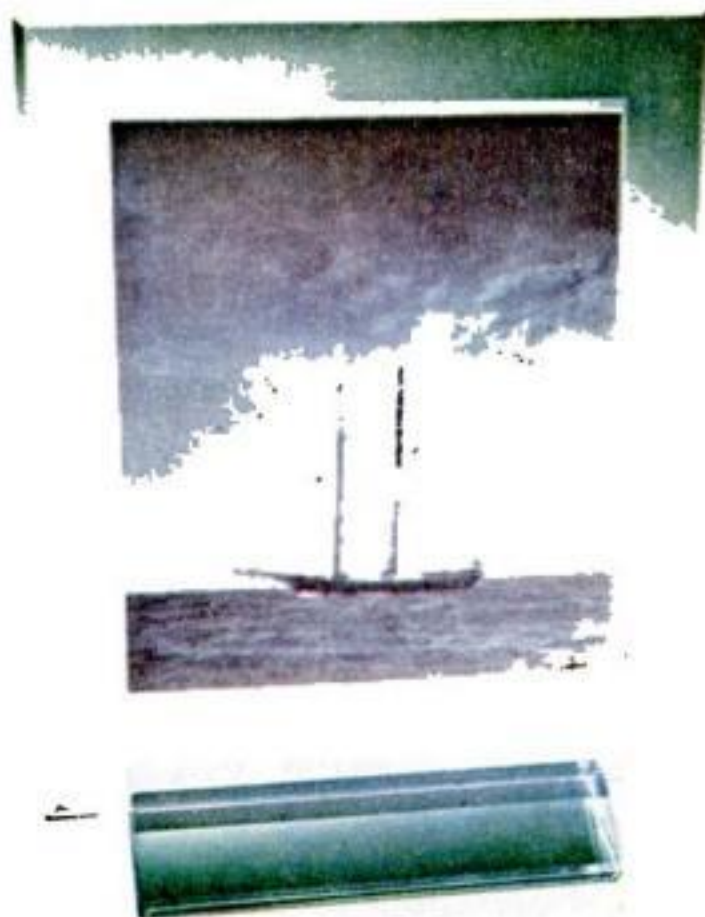
The origin of the new glass goes back to



**Step wedge** shows exactly how pigmentation changes—first blue and then red—and penetrates with increased exposure.



**Schooner photo** reveals lifelike quality in subtle red overtones of highlights against blue middle tones and shadows.



**From the same negative**, these glass prints show variations resulting from different exposures. Print at right has red highlights and blue shadows, but longer exposure produced the result at left, with red shadows and blue highlights.







To print on glass, it is placed behind an ordinary photographic negative in a printing frame. The procedure is the same as the regular process for printing on paper.



Ultraviolet light makes the exposure. Typical one is 15 minutes at three feet from a 60-ampere carbon arc. Direct sunlight can be used, but it may take all day.

1937 at the Corning laboratory, when Dr. Robert Dalton found that a permanent color difference was produced in ruby glass when it was irradiated with ultraviolet light and then heated.

This suggested the idea of glass that would act like photographic printing paper, on which little particles of silver are precipitated and fixed by light and chemicals to develop the picture. In 1941, after many experiments, Dr. D. S. Stookey found that certain metallic particles could be mixed within glass to reproduce ruby designs in otherwise clear glass.

Soon afterward, the Treasury Department became interested in the glass during a wartime quest for substitutes for metal coins. Treasury officials looked at samples, and were prepared to authorize the manufacture of glass coins. But the enormous quantity needed was beyond Corning's production capacity, so glass money never appeared.

Wartime need for research into other kinds of glass forced a temporary halt in the development of photosensitive glass. But since the war, Dr. Stookey has developed new sensitizers, new colors, increased photographic speed and color intensity.

The tiny metallic particles are everywhere within the glass and are in solution. That is, they are an integral part of the glass. But ultraviolet light makes them precipitate, or come out of solution as something solid and visible. They remain trapped in the glass, however, in precisely the same positions as before. Only ultraviolet light is of the right wave length to affect the particles in this way. Heat fixes the particles and makes the color picture develop. The particles are so fine that the printing is essentially grainless, permitting fine detail without distortion.

If the negative does not cover all the surface of the glass, the remaining portions are masked off with black tape. Thus a small picture or design can be printed on one part of a goblet. The exposure time governs the depth of the picture, and parts of the negative can be exposed longer to create a three-dimensional effect.

The heating after exposure does not fix all the particles within the glass, but its physical appearance remains unchanged unless it is again subjected to the 1,000° temperature—not likely to happen unless it comes in contact with a raging fire.

One kind of glass, because of its ingredients, takes pictures in blue, purple, ruby or orange, and combinations of these colors. Another prints only in brilliant red. Still another gives pictures in yellow and brown. The shade of color is determined by exposure. In one type, exposure for a

Labels and indicator glasses like these are among first applications of photo-glass. Other possible uses include lighted advertising displays and religious emblems.







Glass plate is then put into a furnace and heated to slightly above annealing temperature—about 1,000° F. Once cooled, only reheating it will alter the picture.



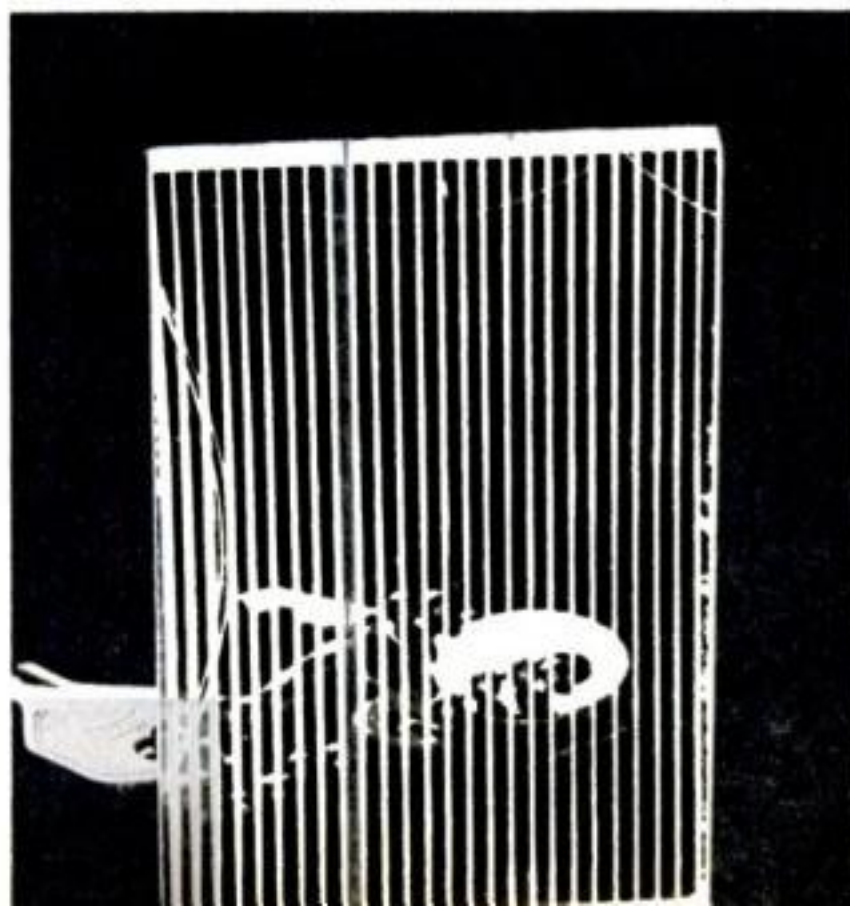
When glass is removed from the oven, the image has become an integral part of it. The depth of image penetration is determined by length of ultraviolet exposure.

couple of minutes makes the entire picture red, but portions of it can be made purple by exposing them longer. Shadowed areas penetrate farther into the glass than the high-lighted areas.

Besides these transparent colors, Corning is making photosensitive opal glass—the white translucent kind used in lighting fixtures to eliminate glare. The opal glass permits printing of three-dimensional designs of microscopic, light-scattering crystals in any pattern in clear glass. These can be red, blue, yellow, brown, or white, and certain combinations of these colors.

Transparent and opal glasses can be combined in designs side by side, or one can be superimposed on the other so that the opal makes a background for a transparent colored image. Ribbons of opal crystals can be extended through a plate of glass like venetian blinds and used in

Bands of the opal glass, running through a plate at an angle, can be used for a diffusing glass louver. Seen head-on, parallel to angle of exposure, it is transparent.

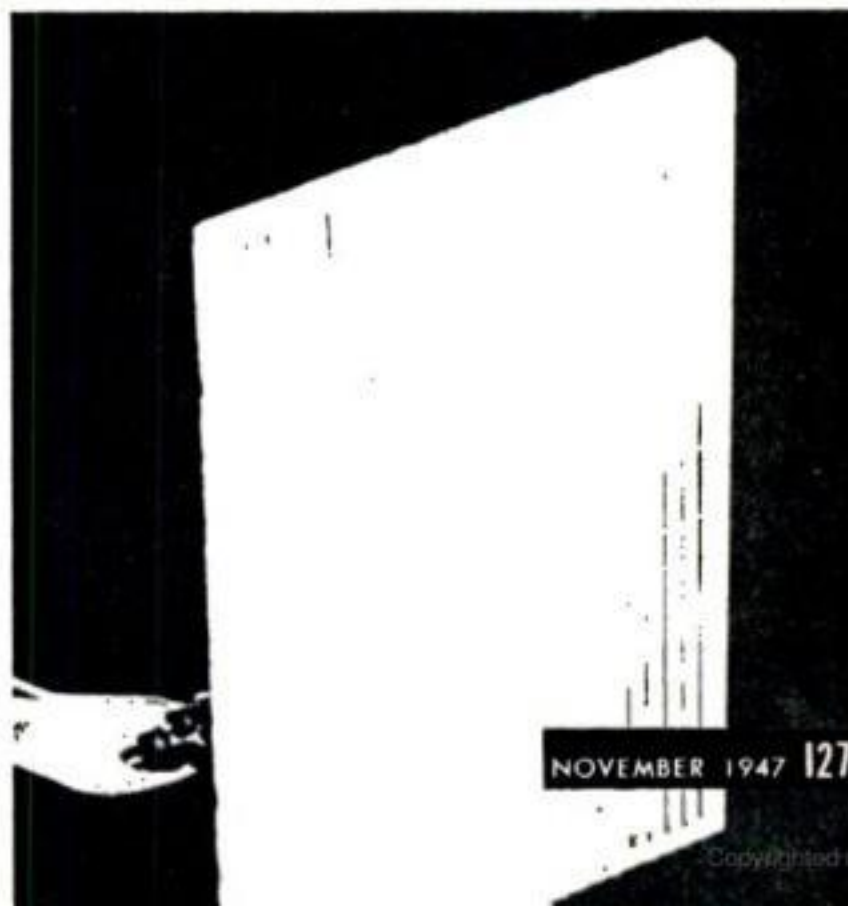


lighting fixtures to direct bright light onto some areas while others are illuminated with soft, diffused light.

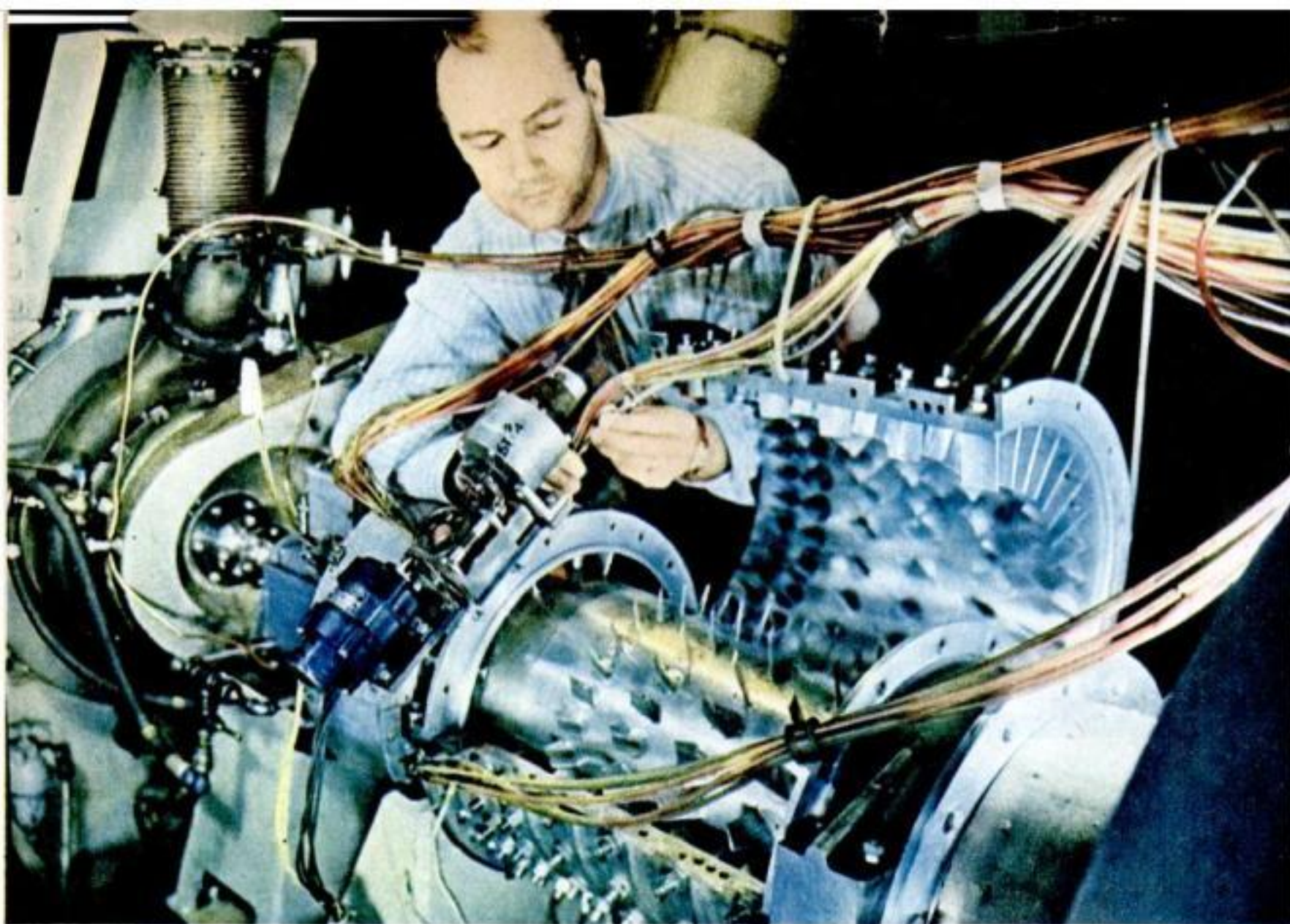
Light placed behind a glass picture enhances its effect. So does etching the back of a piece of the glass. Corning foresees use of the glass for portraits, scenic photographs and miniatures. Other possible applications include goblets, vases and tableware; costume jewelry such as signet rings; church windows, photomurals with or without lighting, and decorative tile; permanent microfilm records, instrument dials that are heat- and scratch-resistant; and lantern slides for projection.

Photo-glass is a new pictorial medium—a December-May marriage of the ancient art of glassmaking and the younger craft of photography. With it, portraits in glass may someday be treasured as family heirlooms—enduring for centuries. **END**

But when you look at the louver at an angle, as below, the streaks of opal glass act as a venetian blind, blocking any view of what lies beyond but admitting light.







Developing gas turbines of the future, Boeing engineers test new types of compressor blades.

## Turbines For Autos?

**Mighty power of midget models, now becoming available, foreshadows era of new uses for jet power plants.**

**W**ILL gas turbines, new standard for military aircraft and the coming thing for civilian planes, drive automobiles next? High horsepower-to-weight ratio afforded by big jet engines interests automotive en-

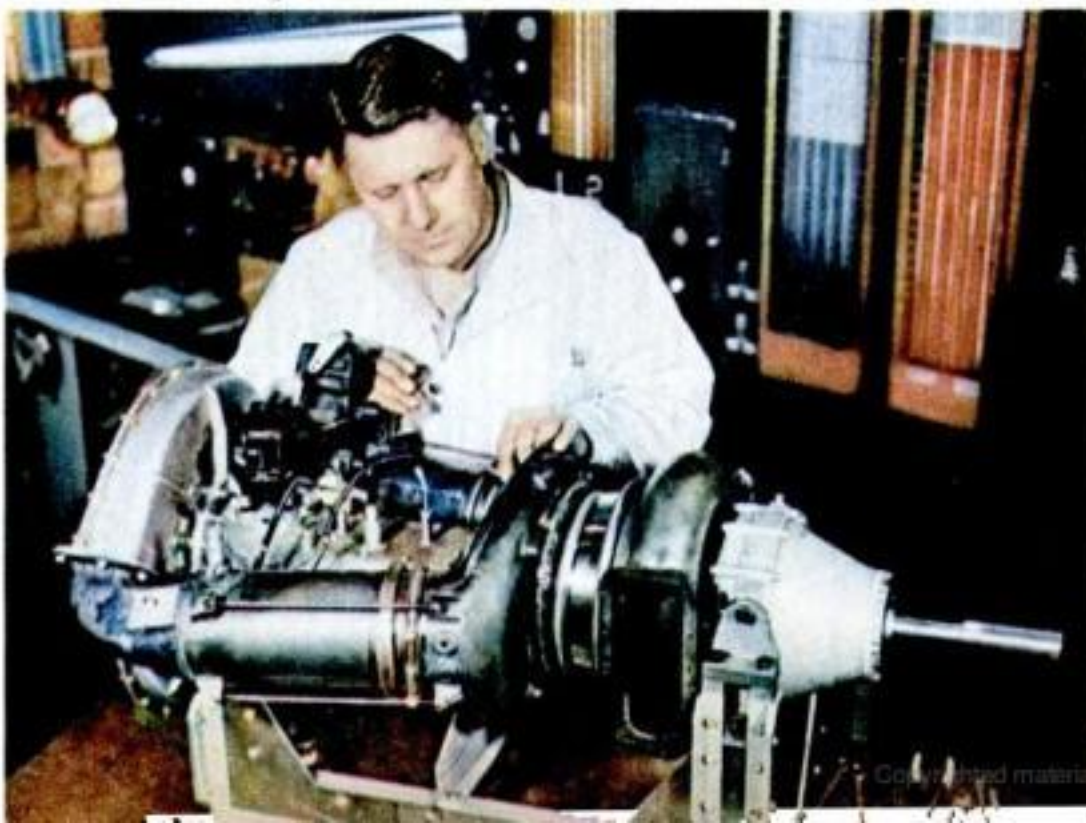
gineers in new and smaller power packages.

Boeing's Model 500, an 85-pound midget for small planes, furnishes all its power in a jet. But a modified, turboprop version, Model 502, might be a prototype of gas turbines for automobiles, boats and stationary power plants. This 140-pound engine delivers 200 horsepower, double the output of a 500-pound auto engine, to a mechanical drive. Its 7½-inch turbine wheel is turned by twin burners, possible equivalent of cylinders in tomorrow's cars.

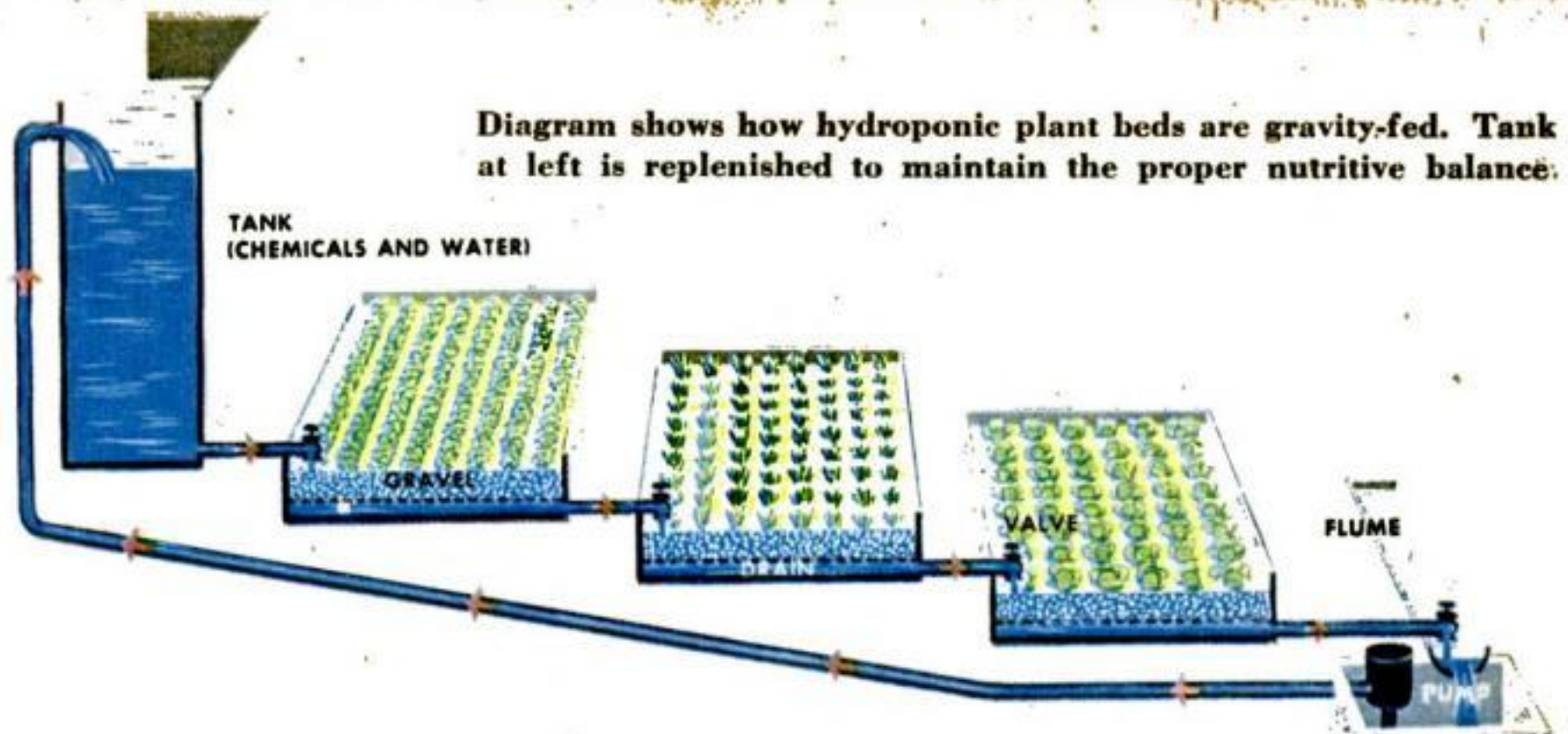
Evolution of a gas-turbine automobile will require improved fuel economy, and a means of diverting or eliminating rearward jet exhaust—but neither seems impossible.

**Model 500 turbojet engine, weighing only 85 pounds, may prove to be starting point in evolution of gas turbines for motor cars.**

**Turboprop version, Model 502, weighing 140 pounds, makes the next step by harnessing its 200 horsepower to a mechanical drive.**







# Multitude Fed Without Soil

*And when it was evening, His disciples came to Him, saying: This is a desert place . . . send the multitude away. . . . But Jesus said unto them: They need not depart, give them to eat. MATT. XIV: 15, 16.*

On Ascension Island, Army Air Forces base in the Atlantic Ocean, there was no soil at all, but a multitude was fed fresh vegetables from hydroponic gardens. Now an even greater multitude is being fed the

same way. This year, 100,000 men of our occupation forces will get eight salad meals a week from the yield produced by the world's largest soilless farms, covering 80 acres in Japan.

Hydroponic gardens consist of long, shallow troughs of concrete or asphalt-lined wood filled with washed gravel, volcanic cinders, or other inert material in which seeds are placed or small plants set to take root. A gravity system feeds the beds

These six-foot tomato plants, hydroponically grown, will add 1,000 tons of health to the meals of our occupation forces in Japan

this year. To the right of the tomatoes is a prime bunch of celery; its clean roots have never been near the earth.



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Beds are fed several times a day with a chemical solution, which drains into flume and then is pumped back to the supply tank.



Japanese girls seeding beds of the Army's hydroponic farm at Chofu, near Tokyo, Japan. This farm covers 55 acres.

with a chemical solution needed for growth.

But it's an expensive business in dollars and cents when compared with commercial soil-grown vegetable market prices. Therefore the Army, the only agency that has had large-scale, out-of-the-laboratory experience with hydroponics, sets strict limitations for its use.

The chief restriction is that hydroponics should be used only where there is no soil, as is the case on volcanic islands and desert locations, or where the soil, through

the use of human fertilizer (as in Japan and China), is unfit for the growth of vegetables that are eaten raw. Vegetables that are cooked before eating can be obtained much more cheaply in canned, frozen or dehydrated form.

Despite its limitations, the Army's war-born experience has proved that hydroponics is practicable on a large scale. Further experience and experiments will undoubtedly tailor the chemical garden to peacetime needs. END

Rich chemical solution makes plenty of work for weeders in this 30-day-old lettuce patch.





# I'd like to see them make...

Cartoons by Syd Landl

Everybody has his own pet idea of some gadget he would like to see in general use. What is YOURS? *Popular Science Monthly* will pay \$5.00 for every such suggestion that it accepts for publication. Contributions cannot be acknowledged or returned.



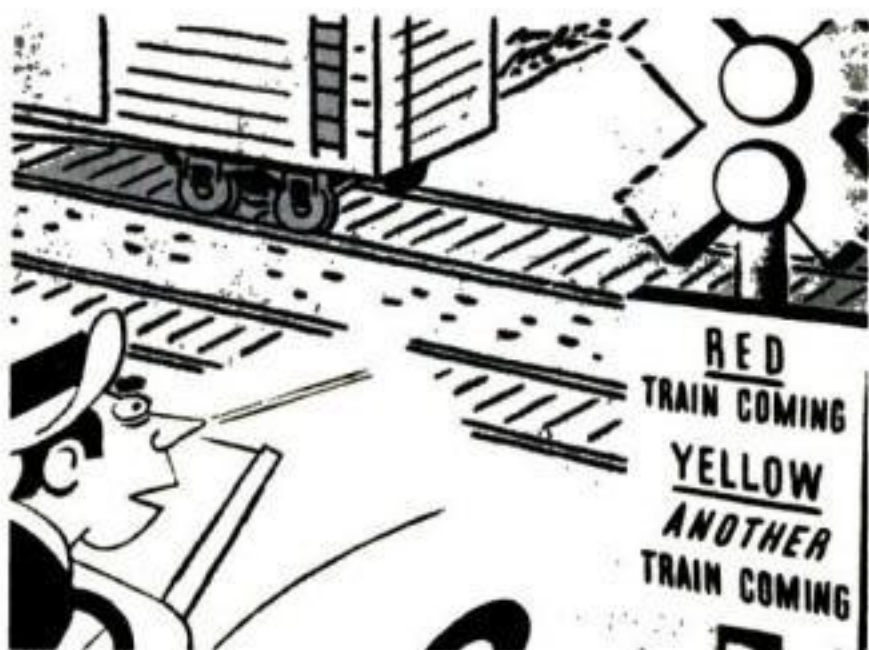
**Mailbox Stamp Dispensers.** Coin-operated postage stamp venders attached to all mailboxes on street corners would save many weary steps to the postoffice, declares Henry Hupka, of South Bend, Ind.



**Heated Steering Wheel.** To warm the hands of those who prefer to drive in winter without gloves, Mrs. John Halacy, of Joplin, Mo., would like to see heating coils embedded in the steering wheel.



**Built-In Dirt Collector.** A removable bucket, concealed beneath the floor of each room by a foot-operated trap door, would avoid stooping to reach the dirt, asserts Mrs. L. A. Kerat, of Seattle, Wash.

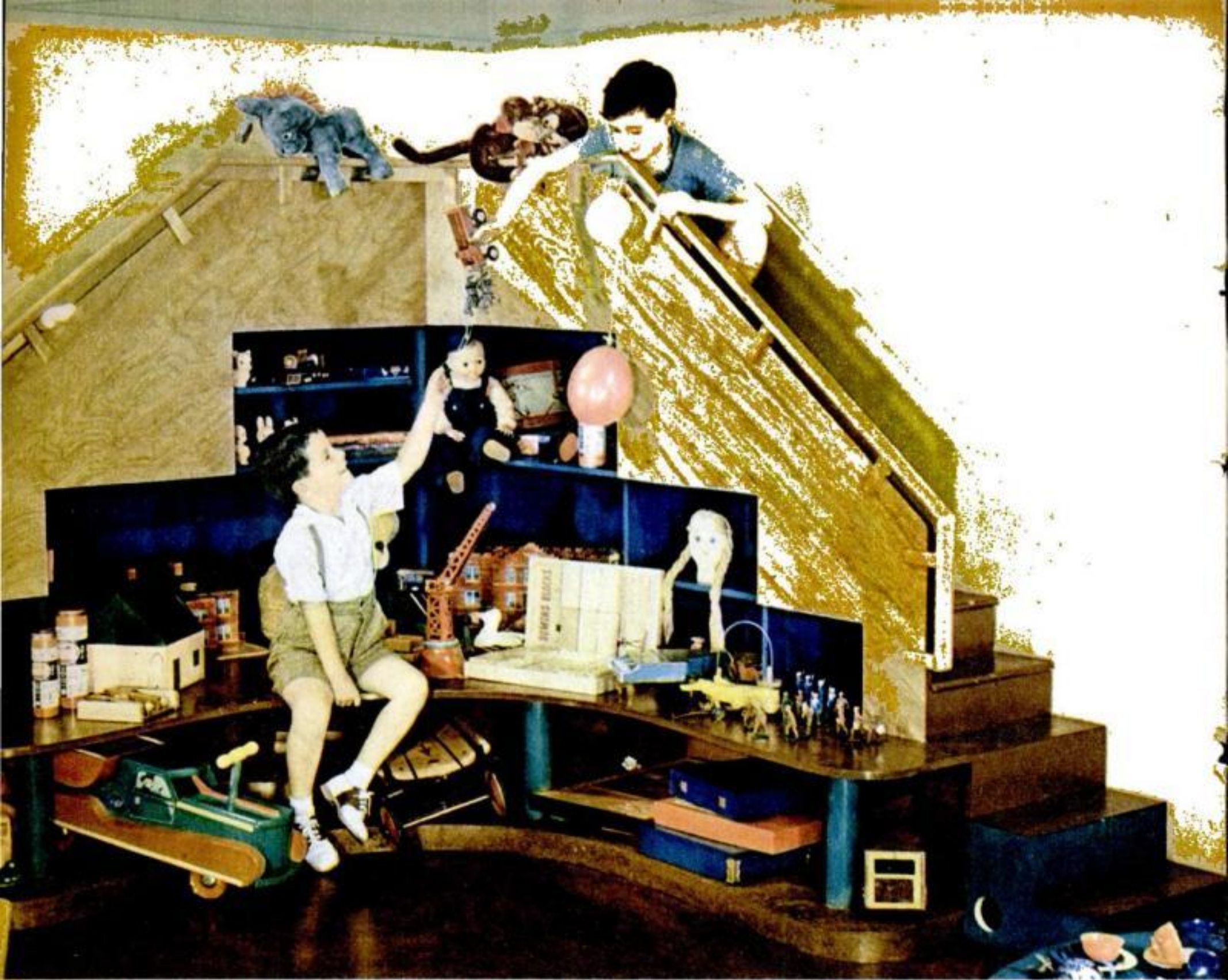


**R. R. Safety Signal.** A second light of a different color to signal the approach of another train after one has already passed a crossing would reduce accidents, says George A. Budd, of Clearfield, Utah.



**Noncramping Crib.** An adjustable crib that can be enlarged as the baby grows would save space and eliminate the extra expense of a regular bed, points out Mrs. Anna Mitchell, of the Bronx, N. Y.





*One side of the double stairway, which leads nowhere but up and down, can be converted into a slide. The wide, elevated play shelf keeps the children off the floor and out of the way of drafts; it also serves as a roof for the garage space provided underneath.*

# Toys and Ideas Fill Kids' Rumpus Room

A MODEL playroom—a child's dream world from floor to ceiling—has been designed by architect Joseph Aronson for the American Toy Institute, research division of Toy Manufacturers of U.S.A., Inc.

The idea of the 12- by 18-foot model room is to get the most out of maximum play area in minimum space in a way that the average home owner can duplicate, either in a whole room or in a corner of a bedroom. The model emphasizes elevated play areas and ample, easy-to-reach toy-storage space. A linoleum floor with inlaid patterns avoids the splinter hazard and doubles as a hopscotch field. Dust-catching decorations and sharp corners are eliminated, and bright colors add the finishing touch.





*The train table, supported by a plywood desk, is a hinged door that folds up against the wall to cover the shelves on which rolling stock may be safely stored. A door in the hollow desk (seen at left) goes nowhere, but creates a hideaway "cave."*

*As modern as the playroom itself is the special children's furniture, also designed by Mr. Aronson. The plywood shelves, in a variety of heights and widths, help simplify the task of teaching youngsters how to be tidy with their playthings.*





# Signal Corps' New Tricks

PSM photos by Hubert Luckett



**Improving Nazi Radar.** The Army Signal Corps has big plans for this huge "Wurzbürger" radar, built by the Germans. At the Evans Signal Laboratory, Belmar,

N. J., the parabolic antenna will be replaced by an even larger one to shoot signals to the moon. A "bedspring" antenna made the first moon contact (PSM, Mar. '46, p. 93).



**Plastic Aids Tube Surgery.** This thyratron tube has been cut in half, but thanks to a plastic the delicate parts are safe. The Signal Corps uses the sections to show how the tube works. The specimen is first dunked in molten methyl methacrylate (lucite) and punctured. The vacuum inside the tube quickly sucks in the plastic. When the lucite hardens, the tube can be sawed lengthwise.



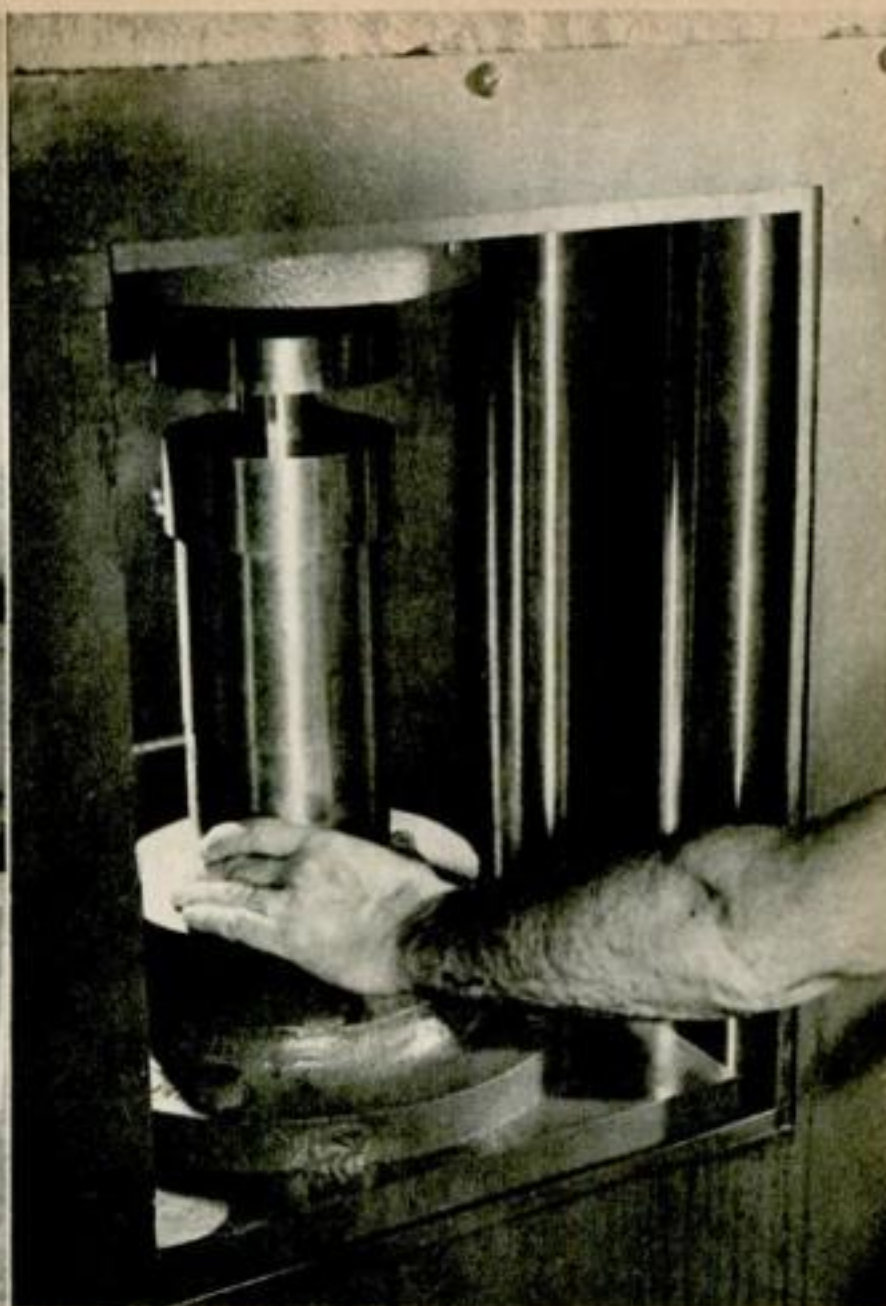
**Ack-Ack Accuracy.** This apparatus tells a gunner just how close he came to the target. Two microphones, each with its own transmitter, are mounted in a target towed by a plane. The two microphones each pick up the shell's shock wave and transmit it to ground receivers. Computers use the time lag between the signals to figure how far off target the missile was. (Direct hits, naturally, are disastrous.)



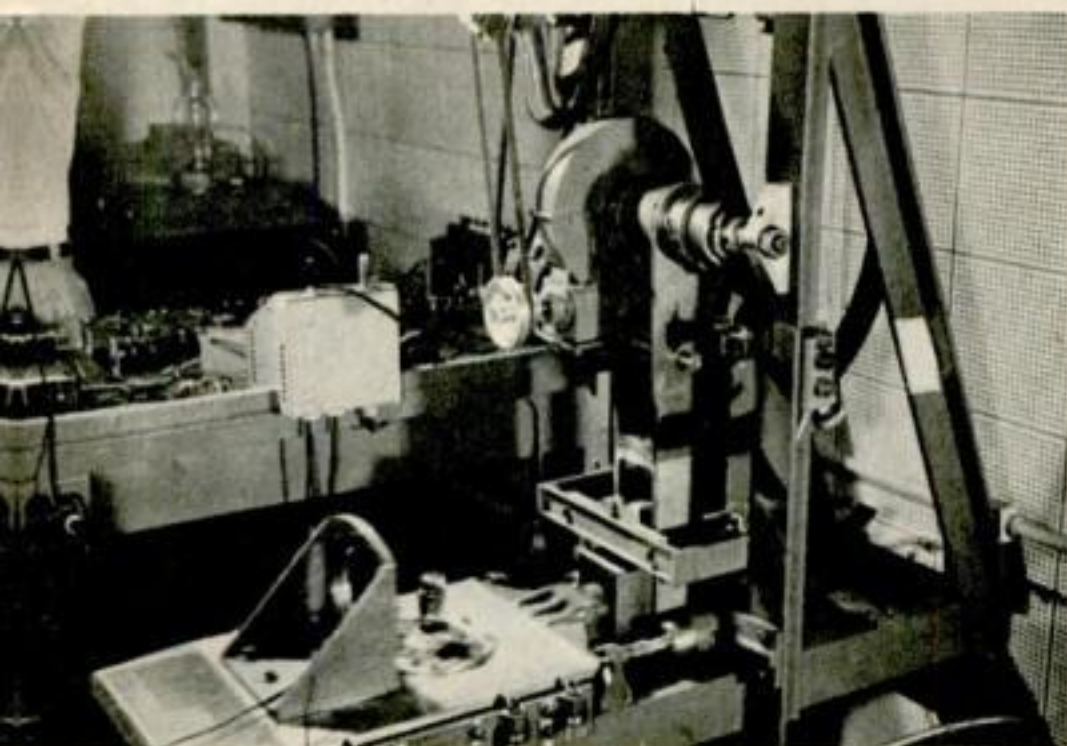


### Stamping Magnetron Parts.

Anodes for the magnetrons that generate radar pulses can be turned out cheaply with a new process, in which a die in a



300-ton hydraulic press stamps slots in a copper blank. Photo at left: blanks before and after stamping, die between them. At right, jig with blank and die is put in press.



**Tubes Get Tank-Ride Test.** This heavy hammer slams a 6Y6-G amplifier tube to see how long it could take a rough tank ride. Note the blurring as the tube recoils under the impact of a force a thousand times that of gravity. Testing machines are essential to Signal Corps research into the durability of war material. This machine is one of the testers in a soundproof room at Evans Laboratory.



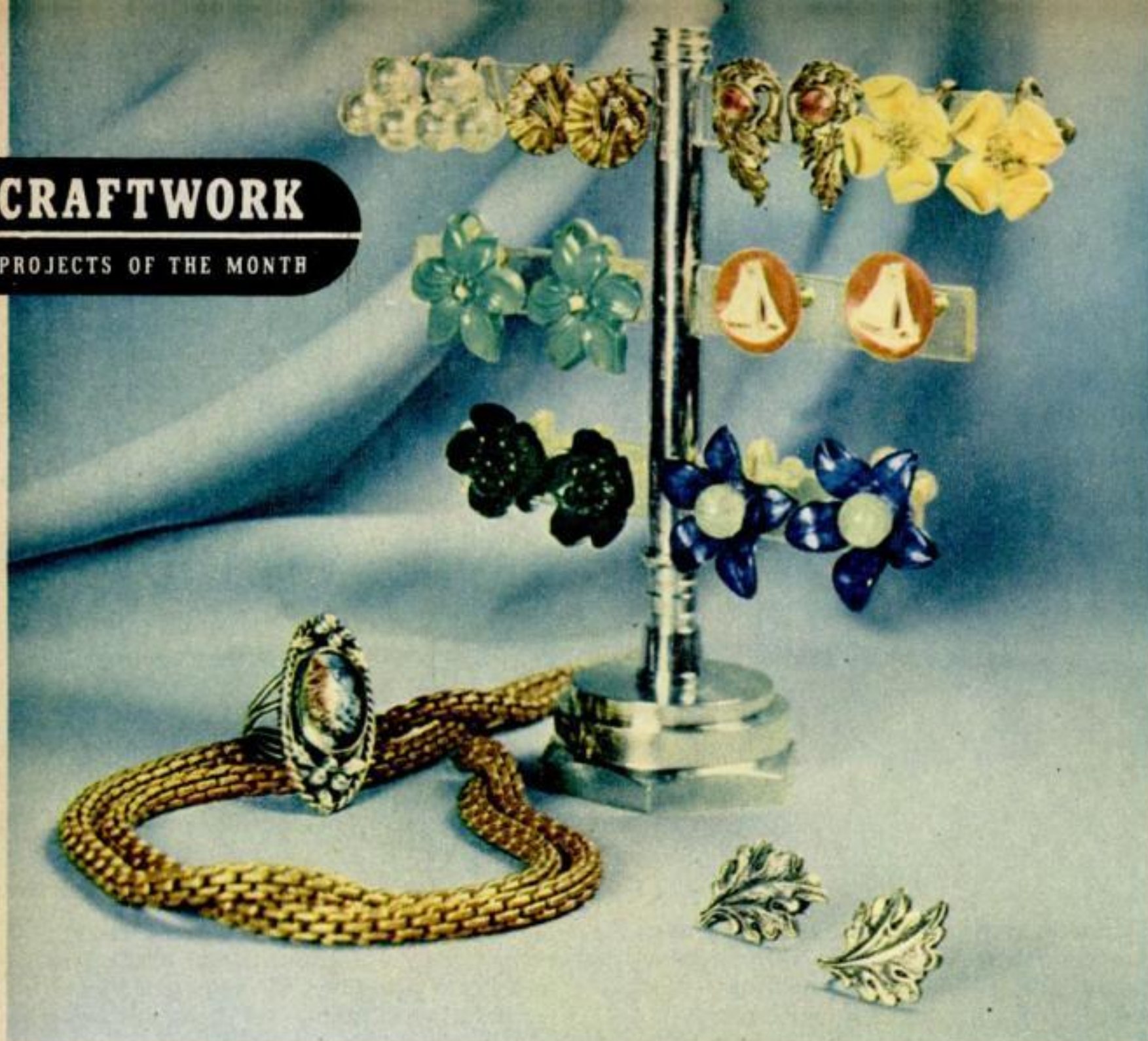
### Radar Tracks Down Mortars.

This portable radar set is Johnny-on-the-Spot in finding enemy mortar batteries. The operator sits at the scope in the trailer, behind a parabolic antenna that automatically scans the sky. The radar picks up a mortar shell in flight at two points on its course. Then an electric computer figures out the complete trajectory and tells where the gun is placed.



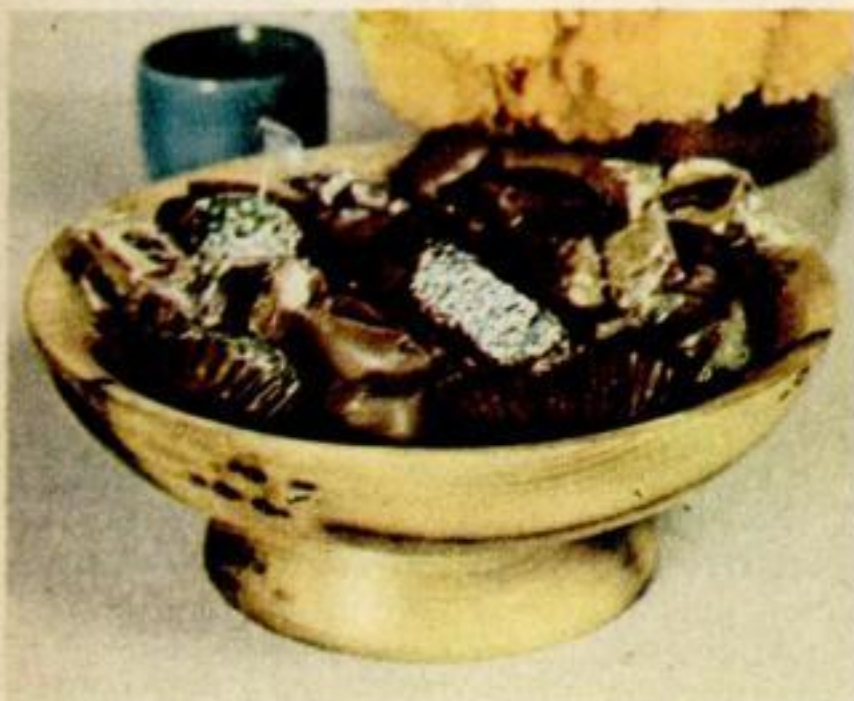
# CRAFTWORK

PROJECTS OF THE MONTH

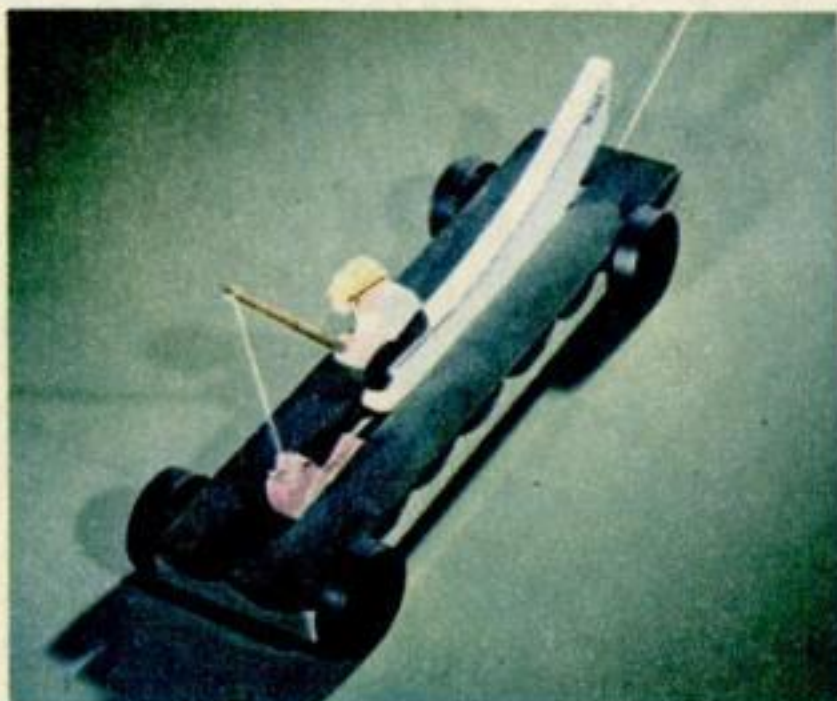


Wandering earrings will stay closer to home if you make your wife this "tree" for her dressing table. If she clips her earrings to the lucite leaves that sprout from the dur-

alumin trunk, there's less chance one will be lost, and she'll also find it easier to pick out just the right pair to go with her ensemble. See page 169 for plans.



Serve it to music. When you pick up this handsome hardwood bonbon dish, a tiny music-box mechanism concealed inside tinkles out a pretty tune. Put it down and it stops. You'll find drawings and construction details of this lathe turning on page 180.



An energetic angler bobs up and down for as long as your youngster draws on the cord of this unusual pull toy. A cam on one axle does the trick. It's a simple shop project, and one that toddlers will go for. Page 174 gives how-to-make dope.



# ***New Typewriter Conquers Chinese Symbols***

**F**OR the first time since the development of modern Chinese script more than 16 centuries ago, a way has been found to copy quickly all of the language's thousands of complex characters. It is the unique "Mingkwai" (clear and quick) typewriter, invented by Lin Yutang, Chinese author.

Reducing a day's hand copying to an hour's typing, the electrically driven machine can print 90,000 characters and reproduce every known Chinese word. Chinese writing does not use the letters of an alphabet; instead, each word is an individual symbol. Other Chinese typewriters require memorizing the position of 5,000 characters and filling in missing words by hand.

A simple, "self-evident" keyboard, the result of 30 years' research, is the secret of Mr. Lin's typewriter. Perhaps even more important than the typewriter itself is the adaptability of the system to typesetting and teletype machines.

The keyboard has 72 keys: 36 representing the top and 28 the bottom sections of Chinese characters, plus eight printing keys. Pressing a top and a bottom key brings the type roller into position to print a "unit" of eight possible combinations of the basic sections—eight different words.

At the same time, duplicate cylinders bring a replica of this unit to where it can be seen by the typist through a "magic viewer" window. He then selects a character by pressing the corresponding key. This turns and shifts the type roller into position and prints the character.

The printing mechanism consists of six cylinders, each having six type rollers that contain 7,000 complete characters and over 1,400 components. Additional words up to a theoretical 90,000 are formed by typing combinations, such as sun+moon, which means "clear." All the characters are duplicated on the six "viewing" cylinders.

Designed for Chinese, the machine can also be used for writing English, Russian, and Japanese by pressing keys that shift into printing position type rollers of faces of the desired language. It types vertical columns, so that when English is used, the typescript has to be turned sideways.

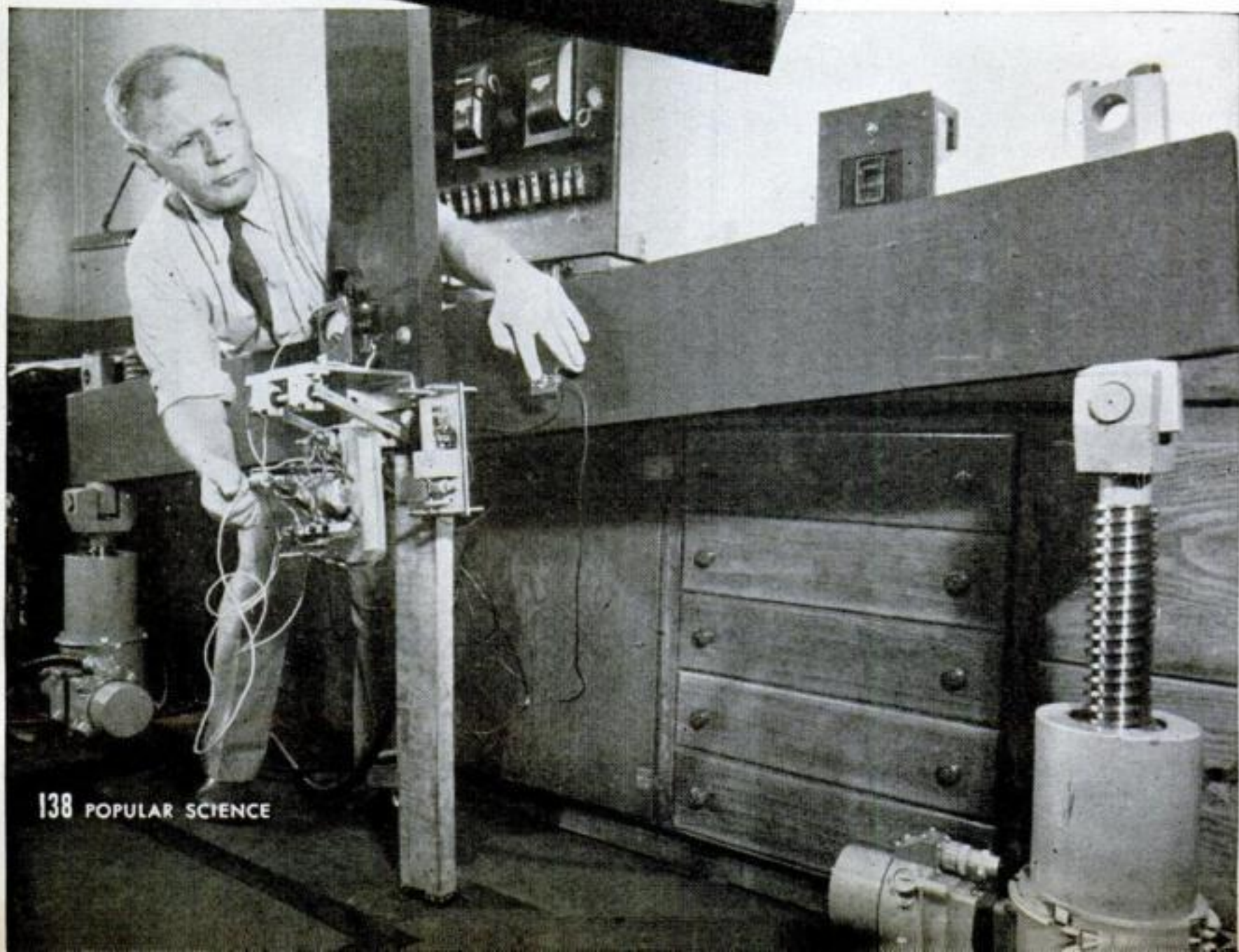


The "Mingkwai," no larger than standard typewriter, has extension on top to accommodate paper for vertical-column typing. "Magic viewer" is seen protruding above the keyboard.

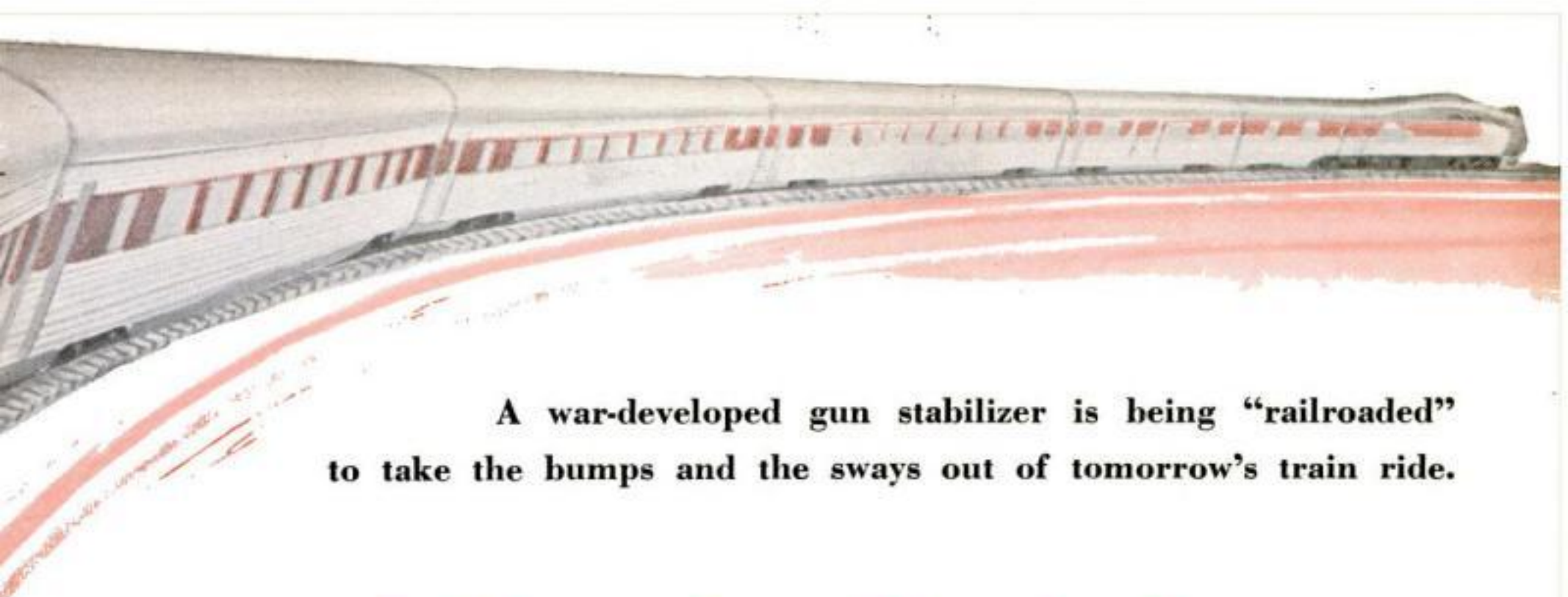


Upper cylinders contain the 36 type rollers. Below them are the smaller hexagonal "viewing" cylinders. Simplified keyboard eliminates memorizing the position of thousands of characters and permits use of touch system for speed typing. White keys at the bottom are the eight printing keys. Operation can be mastered in only a few minutes' instruction.









A war-developed gun stabilizer is being "railroaded" to take the bumps and the sways out of tomorrow's train ride.

# Steel Muscles Snub Bumps On Newest Trains

**Y**OU won't be tossed around when you ride a train fitted with a new automatic "ride smoother." You won't feel the bumps. And your coffee will stay level in your cup even if the engineer takes a curve too fast. Automatic screw jacks will tilt the car's body just enough to provide the right amount of bank.

This "educated shock absorber" for railroad cars is the newest brain child of Dr. Clinton R. Hanna, of Westinghouse, and stems from his tank-gun stabilizer that was used in World War II (PSM, Sept. '44, p. 82). In developing the car stabilizer, Dr. Hanna was assisted by Stanley J. Mikina and Lawrence R. Lynn. Already thoroughly laboratory-tested, the system is now about to be track-tested on an actual railroad car, and a variation is to be tried on large buses.

The shock-absorbing system, capable of ironing out better than 60 percent of the bumps and sidesway, operates hydraulical-

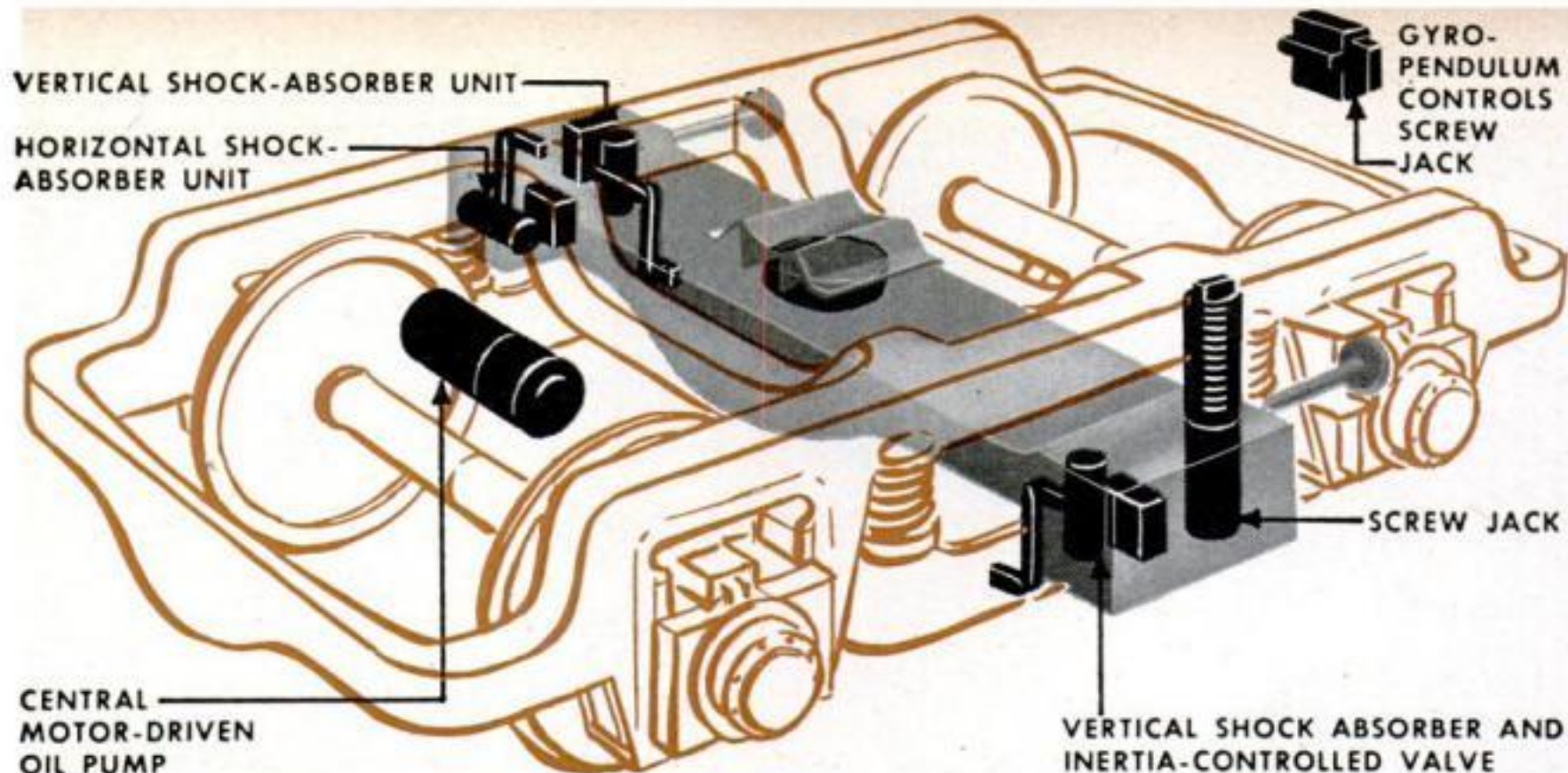
ly and is controlled by a series of almost-human mechanical brains. Each of the two trucks on the railroad car is fitted with three automatic hydraulic shock-absorbing units. Two take care of bumps and dips; the third controls sidesway.

The operating mechanism in each of these units is a hydraulic cylinder fitted with a double-acting piston that can be moved either one way or the other, depending on how oil pressure is applied. The cylinder in each case is fastened to the portion of the truck that supports the car body, while the piston is linked to the main portions of the truck that moves with the axles and wheels. Each end of each cylinder is connected by piping—Dr. Hanna calls it "plumbing"—to a central, continuously operating, motor-driven oil pump by way of an independent inertia-controlled valve.

This unit is the "brain" of each shock absorber. It consists of a sensitively balanced weight and arm connected to two valves in such a way that any movement of the weight opens one valve and closes the other. Thus, the slightest movements of the weight, caused by movements of the truck, control the flow of oil from the pump to that particular shock absorber, routing it to the proper end of the absorber's cylinder to force the piston just the right amount in the

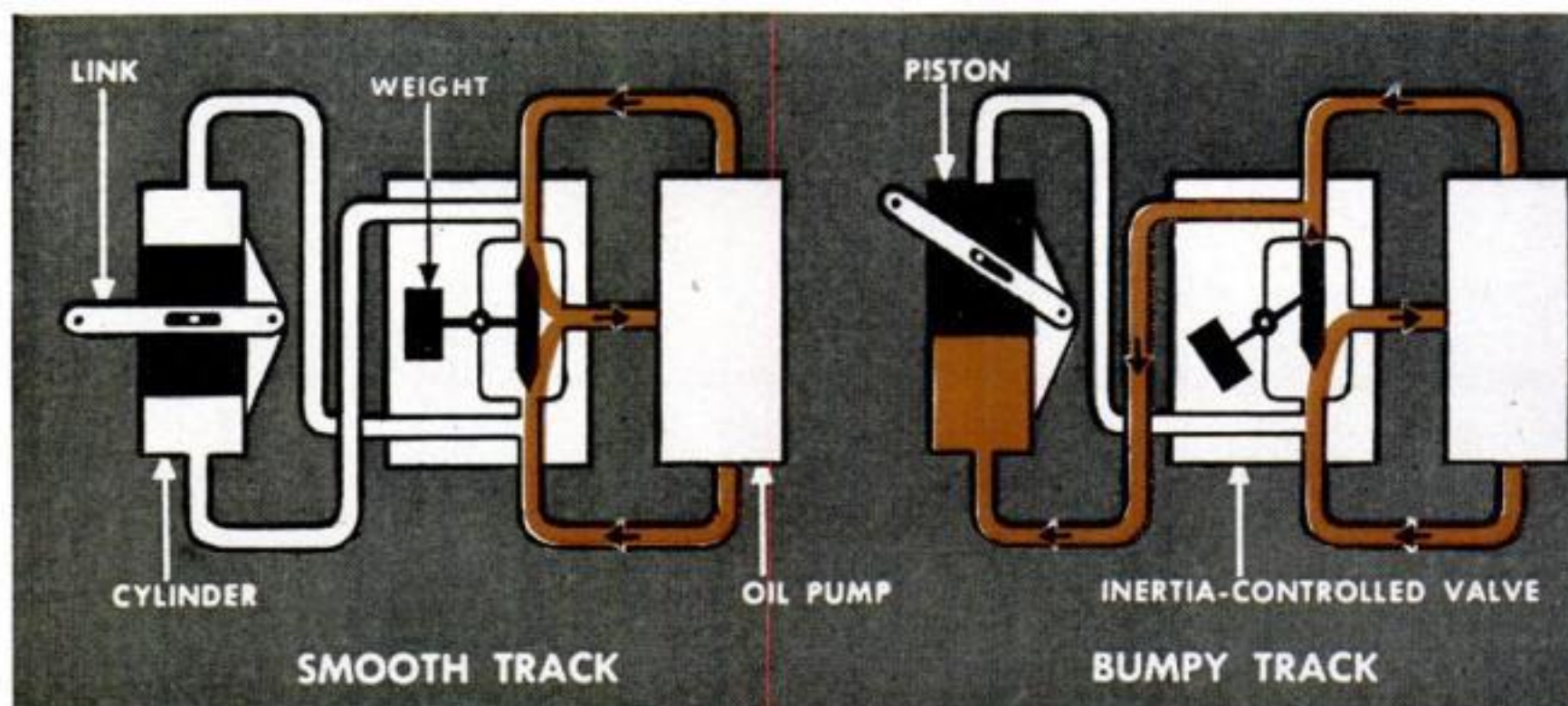
Going around sharp curves at high speed can be comfortable with new "tilt regulator," which tips railroad car inward exactly enough to compensate for outward pull of centrifugal force, as shown at top of page. Westinghouse engineer at left is demonstrating pendulum mechanism activating motors and screw jacks that tilt car a fraction of a second after entering a curve.





**Anticipating movement**, three absorbers on each truck as shown above make corrections—up or down, to right or left—within 3/1,000

second. The gyro-pendulum, a separate unit, controls motor-driven screw jacks that tilt the car to compensate for bank on curves.



**When the car hits a bump**, inertia tends to hold the weight down, which closes the upper valve and routes oil under pressure to the

bottom of the shock-absorber cylinder. This forces the piston and link up to lift the wheels enough to counteract the unevenness.

right direction to counteract the motion and hold the car body steady in its line of travel.

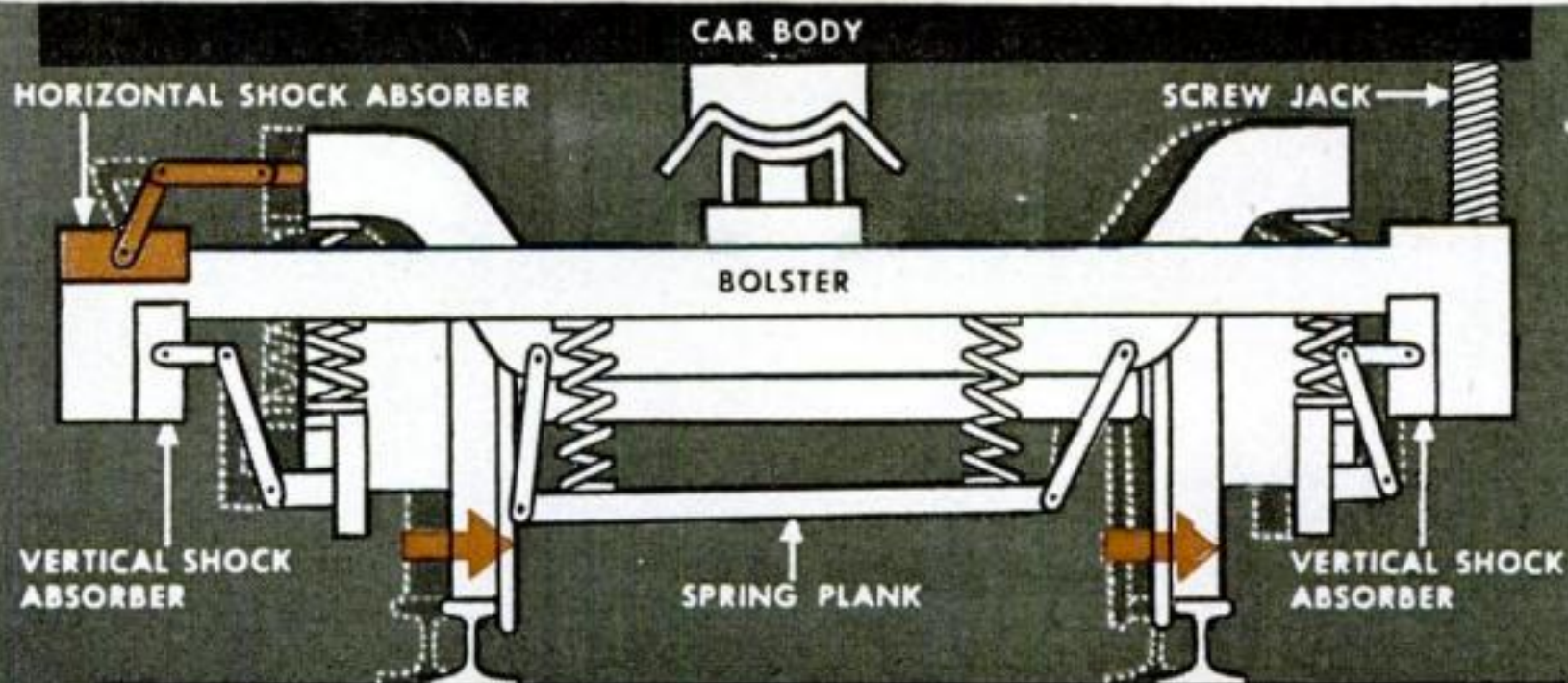
The tilting mechanism that banks the car body just the right amount for the speed on any curve is a separate unit. It consists of a gyro-controlled pendulum and two motor-driven, quick-acting screw jacks mounted at diagonal corners of the car between the body and the trucks.

When the car enters a curve at any but the right speed for the bank of the track, either centrifugal force swings the pendulum out toward the outside of the curve if the speed is too high, or gravity pulls it toward the inside of the curve if the speed

is too low. In either case, the pendulum makes an electrical contact, operating the screw jacks that tilt the entire car body the right amount in the right direction to provide the proper bank. Should the gyro-pendulum fail, a simple weight pendulum takes over.

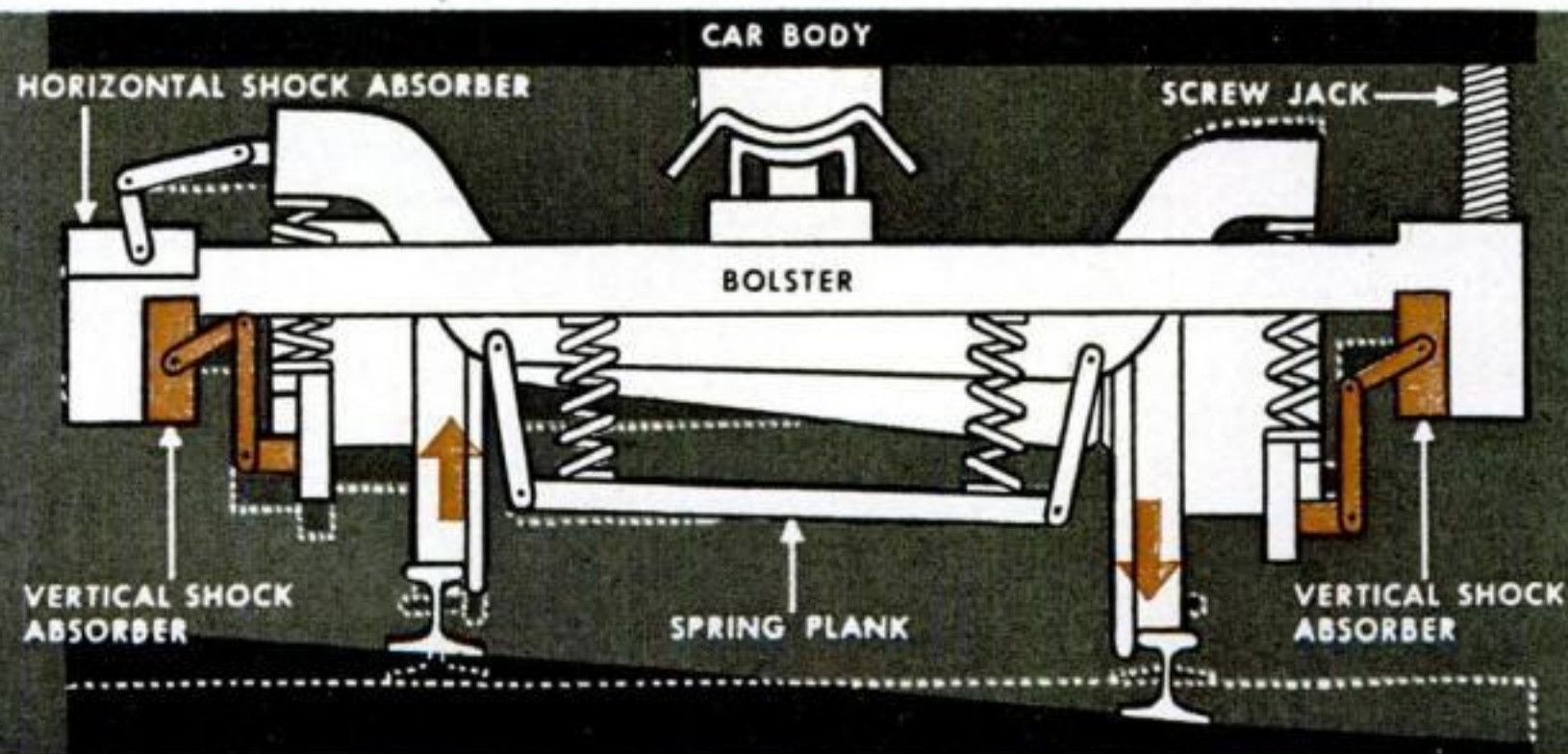
With its present design, the automatic car-banking equipment corrects for tilt within a small fraction of a second after the car enters a curve. In two seconds it can add up to six degrees of additional bank in either direction to compensate for as much as 25 percent overspeed on any curve. Hence, even if the engineer throttled up to 75





To counteract lateral sway, this unit is mounted horizontally on one side of the car truck. It automatically pushes wheels either to right

or left, offsetting any snaking in the roadbed and eliminating the motion that makes you weave when walking through an ordinary train.



Taking care of the ups and downs of railroad travel are these two vertically mounted, hydraulically operated antibounce units. These

"educated" shock absorbers are being tested by one of the largest railroads, and their application to passenger buses is being studied.

m.p.h. on a curve designed for 60 m.p.h., you wouldn't be rolled around in your berth.

The bank compensator also corrects for tilt when the car stops at a station on a curve. When the train comes to a halt, the car is comfortably horizontal even though the trucks are pitched up at an angle.

The combined effects of the educated shock absorbers and the bank compensator on a railroad car, according to Westinghouse engineers, provide a ride four times as comfortable as present-day cars.

The same equipment, modified slightly, can be applied to passenger buses. END

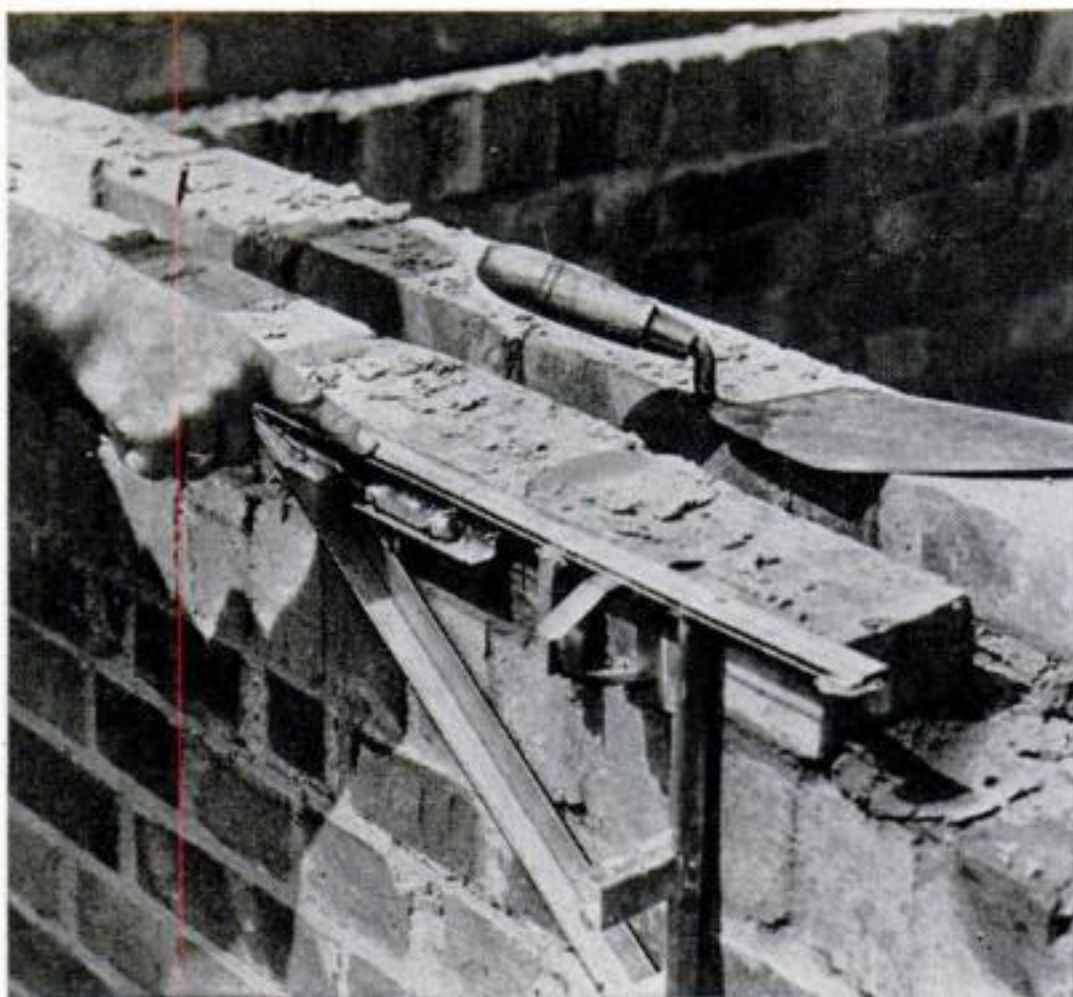
## U-235's Power Shames Coal

Two pounds of uranium 235 would supply a day's power—about 1,000,000 kilowatts—for a city of 1,000,000 people. It takes 3,000 tons of coal per day to generate the same amount of energy.

## Electron: Lightest Lightweight

THE electron—smallest particle known to science—weighs one/thirty-billion-billion-billionth of an ounce. Every second a 100-watt lamp is burning, six million trillion electrons race through the filament.





## Bricklaying Speeded Up

A BRITISH inventor has come up with an aid to high-speed bricklaying that should help solve his country's housing shortage. It is a metal guide that replaces the present length of line used to make sure that all angles of the wall are correct. At left, above, the inventor, Mr. L. S. Beamish, is demonstrating how his new device can be used as a plumb line. The apparatus clips

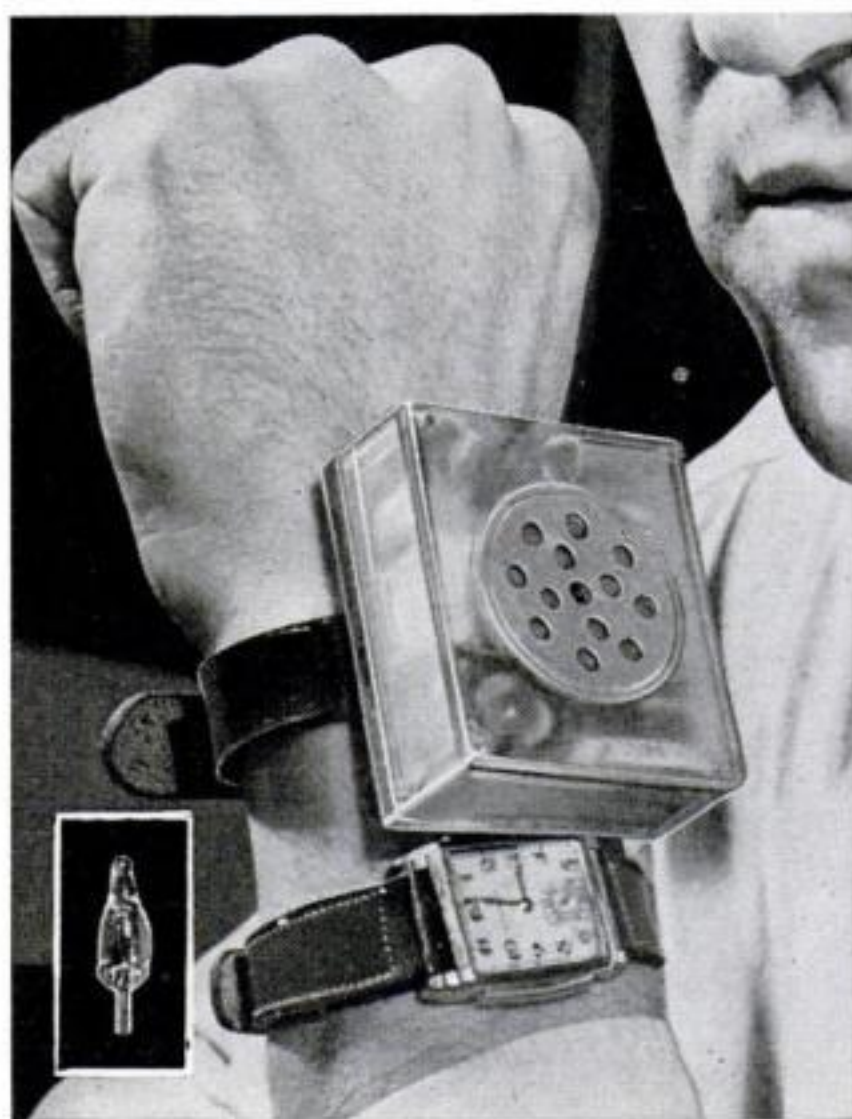
on the top course of the brickwork, and by means of spirit levels and plumb lines keeps both horizontal and vertical positions exact.

Finger in the close-up above is pointing to one of the spirit levels, which checks horizontal accuracy of line. In carefully timed tests, Mr. Beamish, using his device, laid 100 bricks in half an hour, or at the rate of 1,600 during an eight-hour day. Normal amount laid today by ordinary methods is between 400 and 500.

## Tiniest Tube Paves Way For Wrist-Watch Radio

AT RIGHT is shown the comparative sizes of a wrist watch and the new miniature radio transceiver being developed by the U. S. Bureau of Standards. The set both sends and receives short waves and also picks up standard radio broadcasts. It was designed around the tiny radio tube, not much larger than a grain of rice, that is shown actual size in inset at lower left.

This world's smallest microtube was made possible by the elimination of bulky wires, which have been replaced by a silver chloride circuit stenciled on a slice of plastic or ceramic material. Developed as a result of co-operative research with industry, the miniature tube has various military applications aside from its use in the wrist-watch radio. Completion of the latter is being held up until a battery small enough to power the midget is developed.





# Radar Calls the Weather

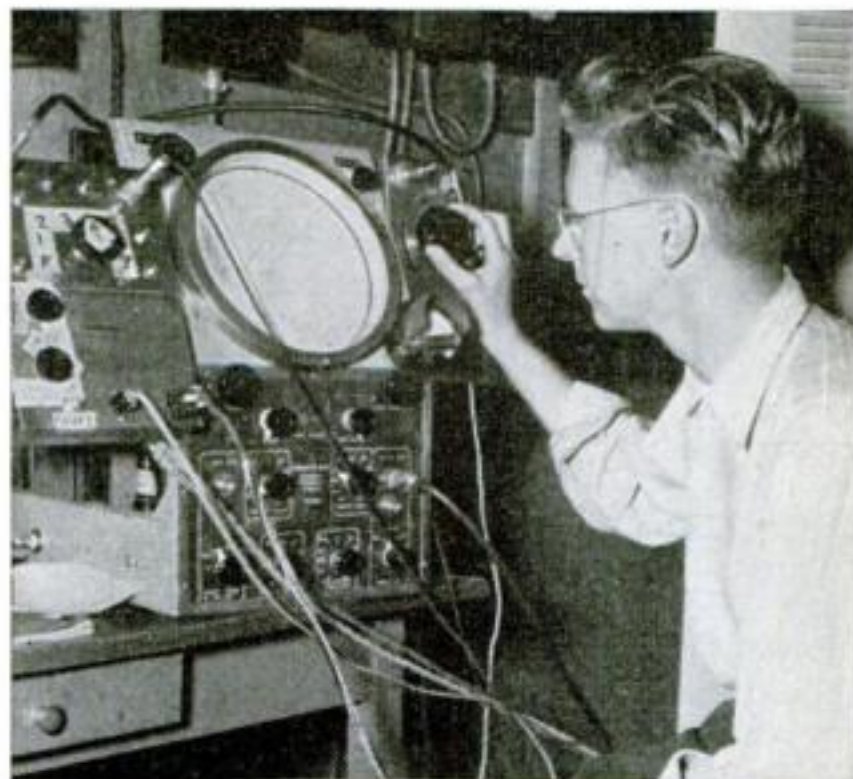
**"IT** IS now 12 o'clock noon. At two, a heavy thunder shower will soak the racetrack, but should end before the first race at 2:30. The storm will not hit the ball park or bathing beaches."

That is the kind of pin-point weather prediction Canadians may soon receive from a new system being developed by the Dominion's Defense Research Board. It uses wartime radar equipment to locate approaching rainstorms and measure their speed and direction. From this data, meteorologists can easily calculate exactly where and when rain will fall. The method permits 80 percent accuracy in forecasts two hours in advance.

Many applications are expected for this new short-range weather service. Canadian Army spokesmen suggest that housewives could be warned to close the windows and take in the wash before going shopping; approaching air liners could be advised of rain expected at airfields; the power company could even be told when dark clouds would cause a sudden demand for electric lights.

Rain (but not fine drizzle) reflects radar waves just the way an airplane does, creating an image of the storm on the viewing screen. Every army and navy radar op-

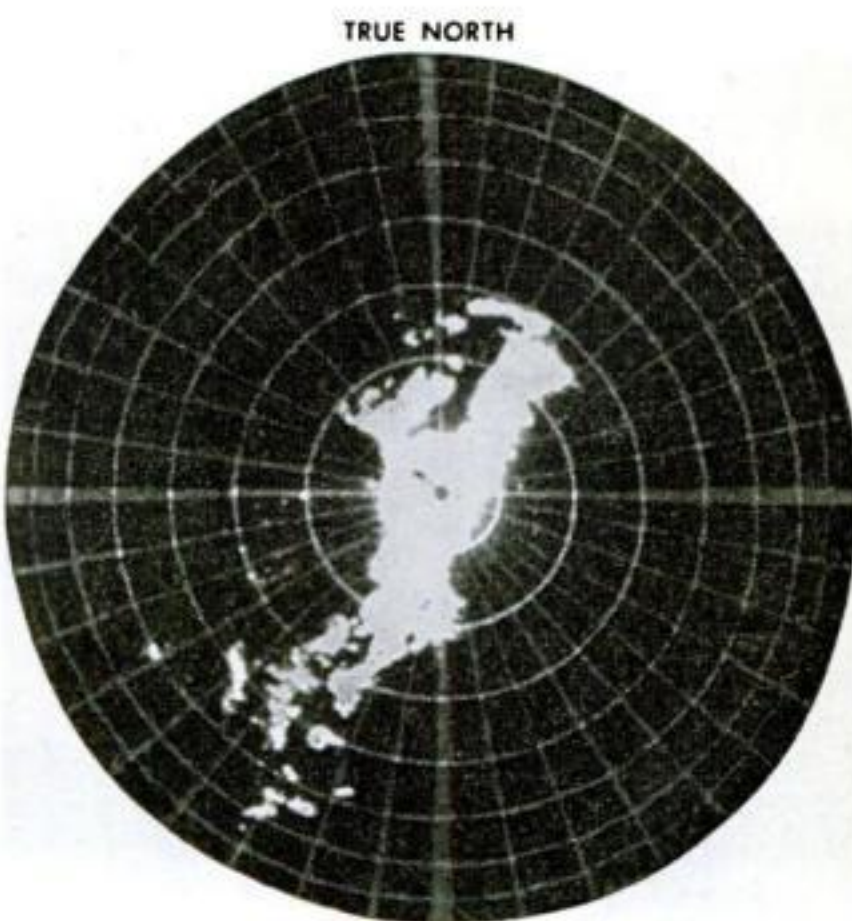
erator knew that, but not until 1944 did Dr. J. S. Marshall, of McGill University, Montreal, begin to develop radar as a meteorological tool. Tests in 1945 at Clinton, Ontario, and Dorval (near Montreal), Quebec, showed the system worked very well. Two experimental installations are now in operation in Ottawa.



**Adjusting radar-scope dials**, a McGill technician measures height of approaching clouds; a second scope measures distance. Range is limited to about 160 miles.



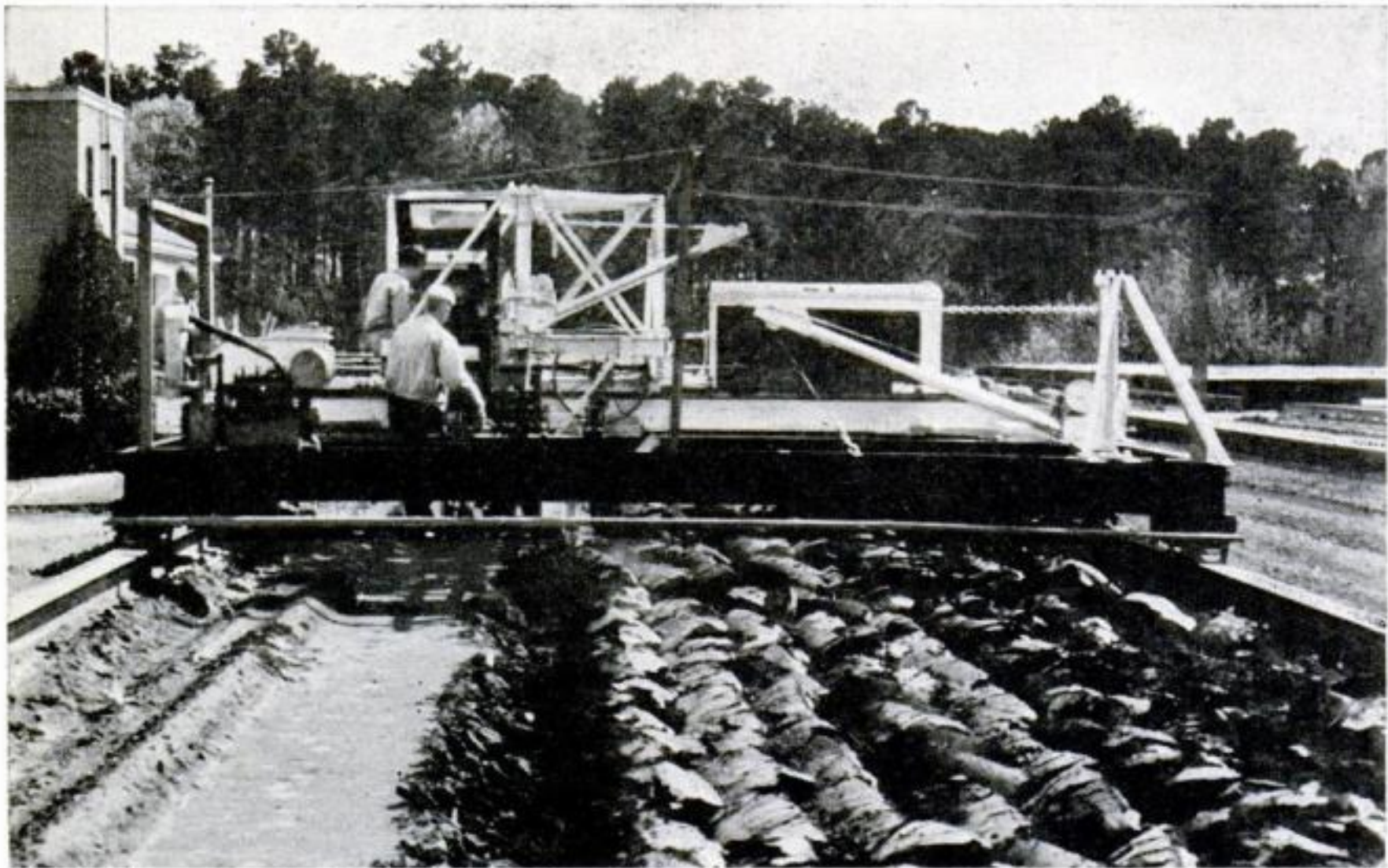
**Storm approaching** over the Laurentian Hills from the northwest at 2:15 p.m. is picked up by radar scope and thrown on screen as shown above. At right, storm is shown hitting Montreal at 4:15 p.m., exactly as predicted by the radar forecaster. Read by expert techni-



cians, these radar photographs clearly show the size, course, depth, speed, and rain density (size of drops) of an imminent storm. Experimental sets now in operation may prove the system's ability to detect forest fires or give warning of approaching dust storms.

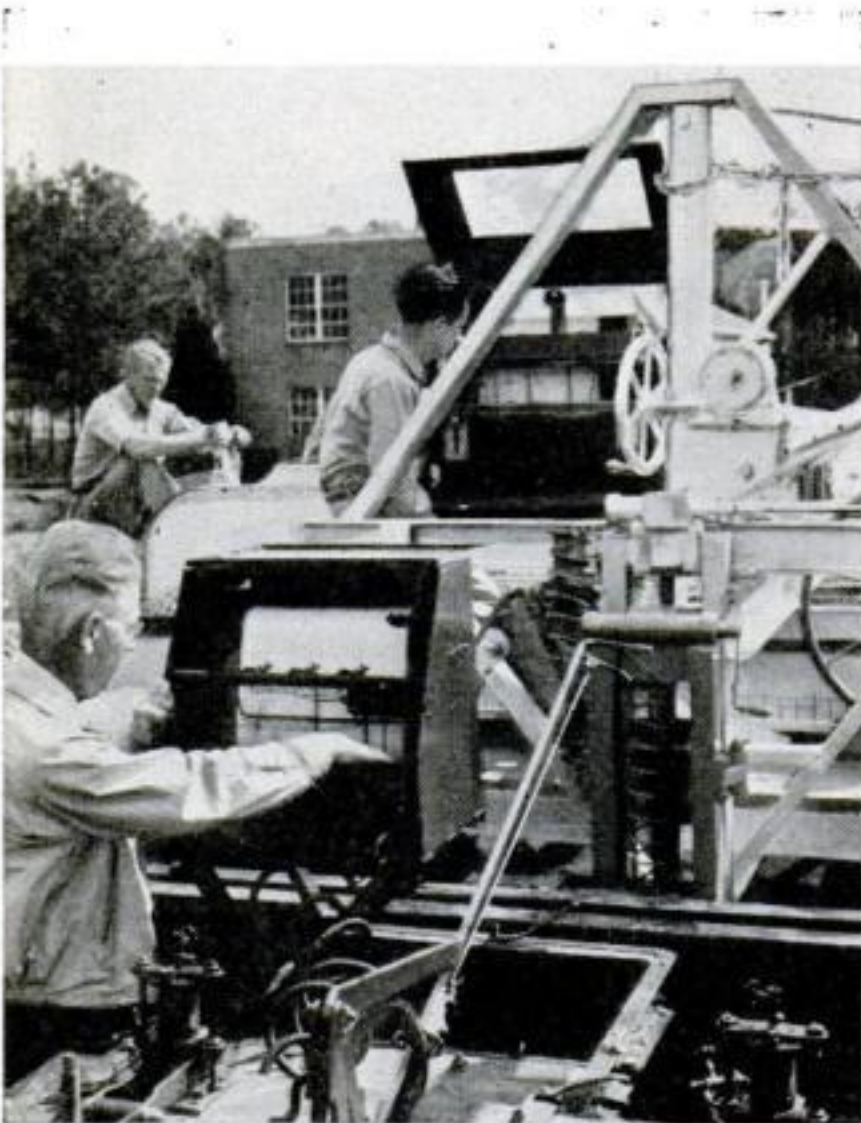


# *“Plow Proving Grounds”*



The 135-hp., motor-driven testing rig, riding on rails that flank the long, narrow test plots, pulls plowbottoms, sweeps, disks and other tillage tools through the various soil types. It

operates at speeds from .2 to 10 m.p.h., pulls drawbar loads up to 5,000 pounds. Here a plowbottom is being drawn through “heavy” soil, one of the 10 representative types.



A dynamometer measures the forward, side and vertical forces exerted by the soil against the implements under test and records them permanently on a time-calibrated chart (above).



This automatic peanut sheller, one of the laboratory’s many developments, shells and cleans 300 pounds of peanuts for planting an hour—as much as 30 men could do in 10 hours.



# Improve Farmers' Tools

WITH special machines and a variety of soil samples, federal farm experts can reproduce almost any farm in the Southeast right in their own acre-sized back yard at Auburn, Ala. Here the U. S. D. A.'s Tillage Machinery Laboratory, one of the first of its kind, is learning just what happens when a farm implement slices through the soil. From such accurate and detailed studies are coming not only improvements in existing machinery but vitally needed new tools.

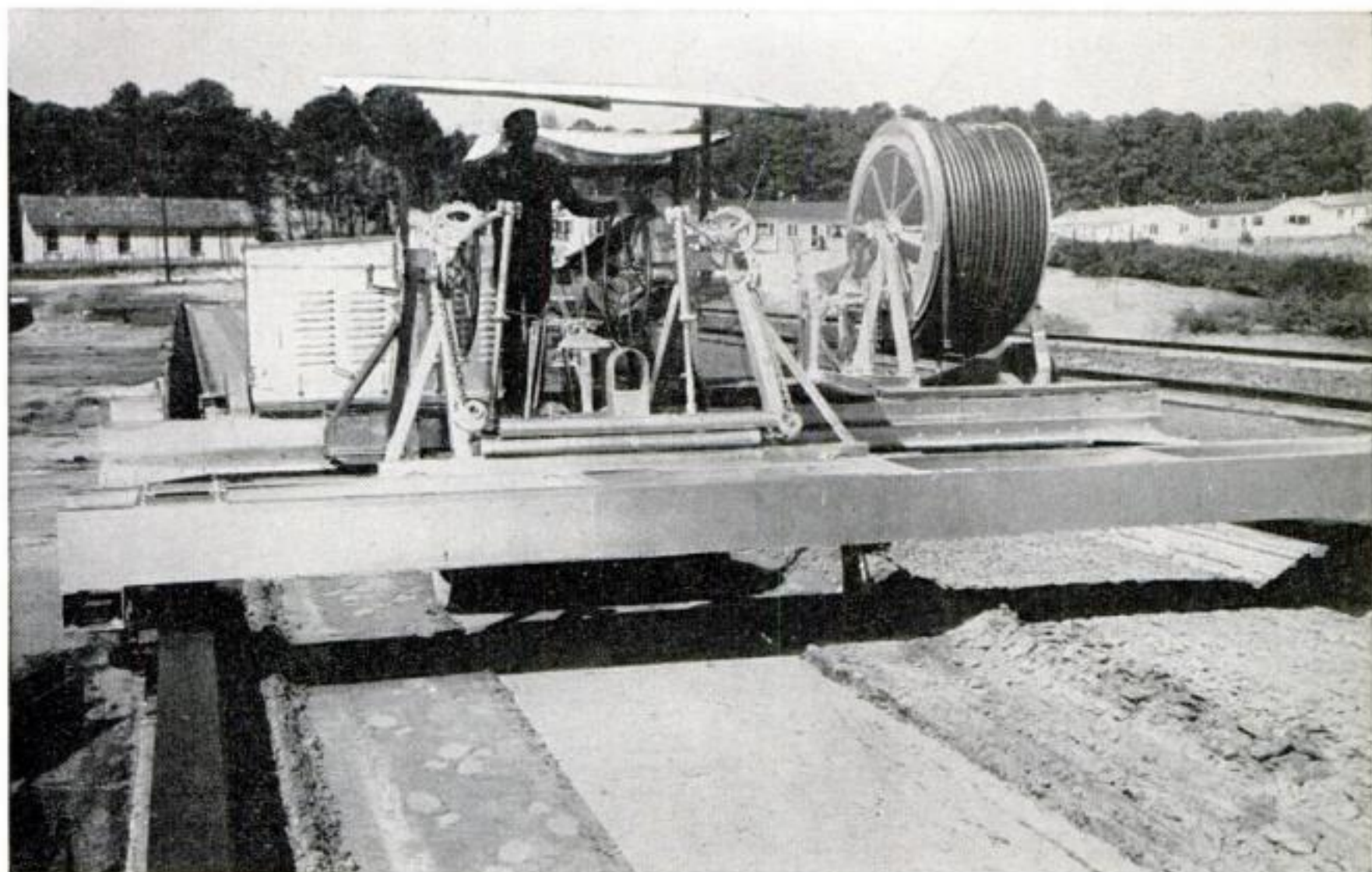
The test grounds are 10 ribbonlike, rail-lined strips, 250 feet long by 20 wide. These narrow "bins" are filled with soils typical of the Southeast, varying from heavy clay to light sandy. Riding the rails above them are two odd but ingenious motor-driven machines looking much like over-sized hand-cars on giant railroad tracks. The first flattens, packs, scrapes or sprinkles the soil as desired, while the second pulls all kinds and sizes of tillage tools through the dirt after it has first been prepared.

More than 3,500 plow and disk tests have already been made at the Laboratory, and the results point the way to better tools and techniques. One discovery, for instance,

was that a furrow slice, once thought to break up into layers that slid over each other as it moved up the moldboard, did so only when the surface earth was hard-packed or matted with roots. Such data help to match plow design to soil condition.

While its chief interest is in soil-working machines, the Laboratory has given much time to designing and testing special equipment. One such development is a tractor-drawn peanut digger-shaker with which one man can harvest 15 to 30 acres a day. Another is a lightweight, portable tung-nut sheller that can be taken into the field.

The Laboratory is especially concerned with the Southeast, since two of the three major crops that have so far defied mechanization, peanuts and cotton, are concentrated there. To break this bottleneck, it has gone to work on such tall orders as a machine that will fallow soil without stirring it deep enough to cause loss of moisture, a cotton planter that will place the seed just below the soil's surface without a furrow, and a harvesting machine that will thresh peanuts while still green to eliminate stacking and improve the soil's fertility.



The soil-preparing machine rides the rails like its tool-testing brother, can be rigged with sub-soiler, leveling blade, disk, subsurface packer, flat roller or sprinkler. It can thus put the soil

in any condition desired for a test. Here loose soil is being packed by a flat roller, will later be planed level. Note the large reel of hose for feeding water to the sprinkling attachment.



# Building A House an Hour



**By Hartley E. Howe**

*PSM photos by W. W. Morris*

**W**HEN the 7:30 whistle blows each morning at a cluster of grey shops just outside Baltimore the yard is packed with the makings of houses—steel joists, lumber, siding, shingles.

By 11 o'clock the top layers of these piles have been built into four walls and a roof. At noon, walls and roof have been moved onto a foundation and assembled into a complete three-bedroom house shell—wired, insulated, and ready for partitions and finish. When the 3:30 whistle stops work for 1,000 men, a dozen house shells may stand where there were only base slabs that morning. When finished, the houses look like the one at the top of this page.

A house an hour, eight to a dozen a day, five days a week—that's what's happening

at Harundale, Md. Here the Byrne Organization, Inc., a large contracting firm, is giving a challenging demonstration of what builders call "site fabrication."

Site fabrication is simply an attempt to gain some of the advantages of prefabrication—assembly-line production, the use of power tools, job simplification—without the drawbacks. The big hitch in prefabrication is shipping the heavy, bulky house sections to the site and lifting them into place. The site fabricator's answer is to ship his entire factory to the site. This isn't as paradoxical as it sounds: he plans to build not just one house, but hundreds or thousands of them, all in one area.

Obviously, this is much less flexible than prefabrication. Not only must many houses be built, but they must be in the same neighborhood and practically identical. Harundale is a good example. It is to have



**Quonset hut shops** in the background house the \$700,000 house factory that is the heart of site fabrication at Harundale, Md. In the foreground can be seen houses in various stages of

completion. At the left are concrete base slabs, then four walls without roofs, then house shells awaiting final touches. Note irregular placing on site to avoid monotony.



1,200 units on a 299-acre site. Except for minor changes, each house is just like those on either side of it.

The houses at Harundale are set irregularly along winding streets among pine groves, but the heart of the project is a group of eight huge Quonset huts shrouded by dust from ever-moving trucks. Four of them house a warehouse, mechanics' and electricians' shops, a carpenter's shop and a paint shop. In each of the other four, a main component of a house is built.

A minimum of lumber—only 1,500 board feet plus 300 square feet of plywood—is used in the Byrne house, as compared to 4,400 pounds of steel. The only parts cut in the carpenter's shop are closet parts, shutters and trimming. These are then taken to the paint shop and spray-gunned, in a fraction of the time hand brushing would require.

#### *House Parts March in Line*

The roof and wall shops are the real core of the factory. Both the roofs and walls are formed out of V-sections of steel, laid out on jigs, cut and welded together. These frames pass down production lines to trucks that haul them to the building sites. Complete fabrication of a roof and walls takes less than four hours.

The plumbing and heating shops finish their work far ahead of the others. Ordinarily one of the most expensive parts of a house, the plumbing for these houses is quickly put together in the shop, first into subassemblies, then into one main assembly for each house. This plumbing system and the heating pipes are fixed in place by the concrete slab, which is poured as much as two weeks ahead of the fabrication of walls and roofs. Only three plumbing connections are made after the plumbing system leaves the assembly line. These are for the kitchen sink, the vent stack and the soil pipe.

The Byrne house has radiant heat provided by hot water piped through the concrete floor slab. The copper coils are welded into six subassemblies in the shop in 45 minutes, then welded together on the site. As the concrete is poured around them they are tested under 250 pounds of pressure—air bubbling through the concrete will reveal leaks that escape the most careful inspection. Using an oil burner, these radiant panels are expected to enable the occupant of a Byrne house to heat his home for about \$64 in a normal year.

Assembly of the four walls and roof is

quickly done, then lathers and plasterers zip up the partitions and finish off the inside walls. Hot- and cold-water pipes, pre-cut in the shop, are installed; the furnace, hot-water heater and kitchen sink connected. Closets go in, final trim is added, and on goes the sale price: for 998 square feet of house on a 60- by 100-foot lot, \$7,450. The stove, washing machine, refrigerator and garage are all extra.

In detail, Byrne site fabrication is flexible. Neither methods nor materials are permanently fixed; siding and roofing are changed on the basis of costs and experience; processes are shifted back and forth between shop and field. But the main principles of site fabrication are held to. Even though only one-fifth of the 1,072 man hours required per house are spent in the shop, they result in a complete house shell, wired and insulated.

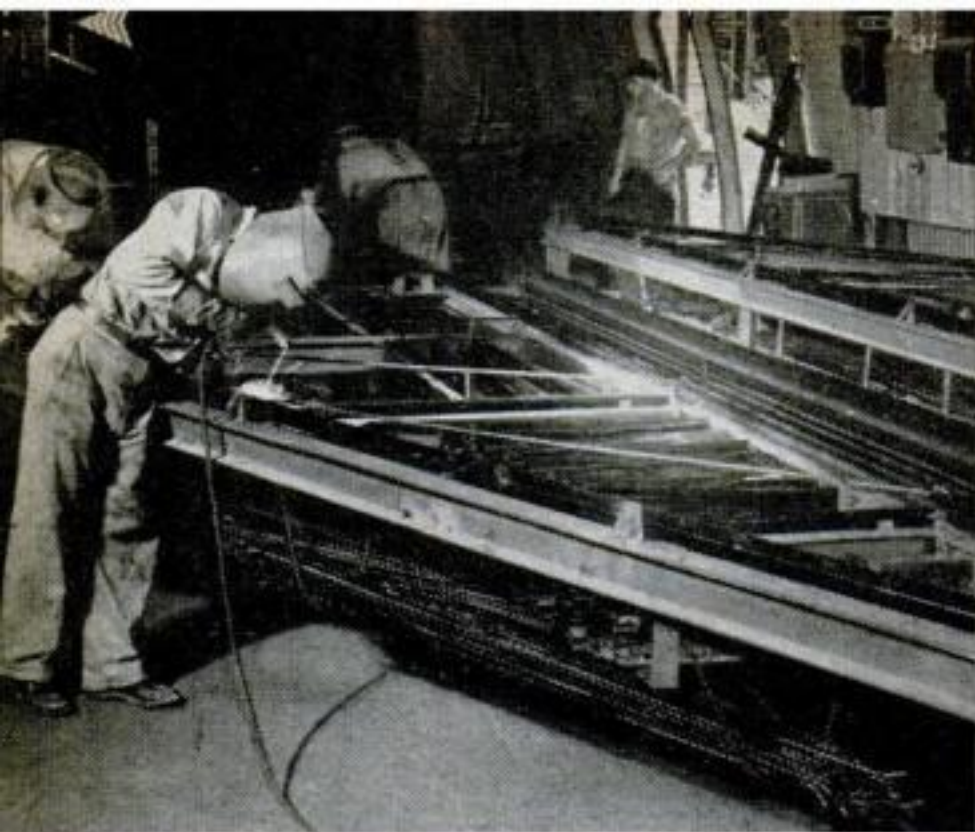
To justify the \$700,000 plant investment Byrne engineers figure they must build a minimum of 500 almost identical houses in one place, even though much of the equipment and shops can be reused. Byrne is already considering moving much of his Harundale factory to Peoria, Ill., where a large company wants a huge housing project site-fabricated for its workers.

Not that the Byrne outfit will wash its hands of Harundale when the last house is finished. Byrne Communities, Inc., will continue to direct a 16-acre shopping center in the heart of the development. Here will be located a supermarket, drug store, restaurants and specialty shops.

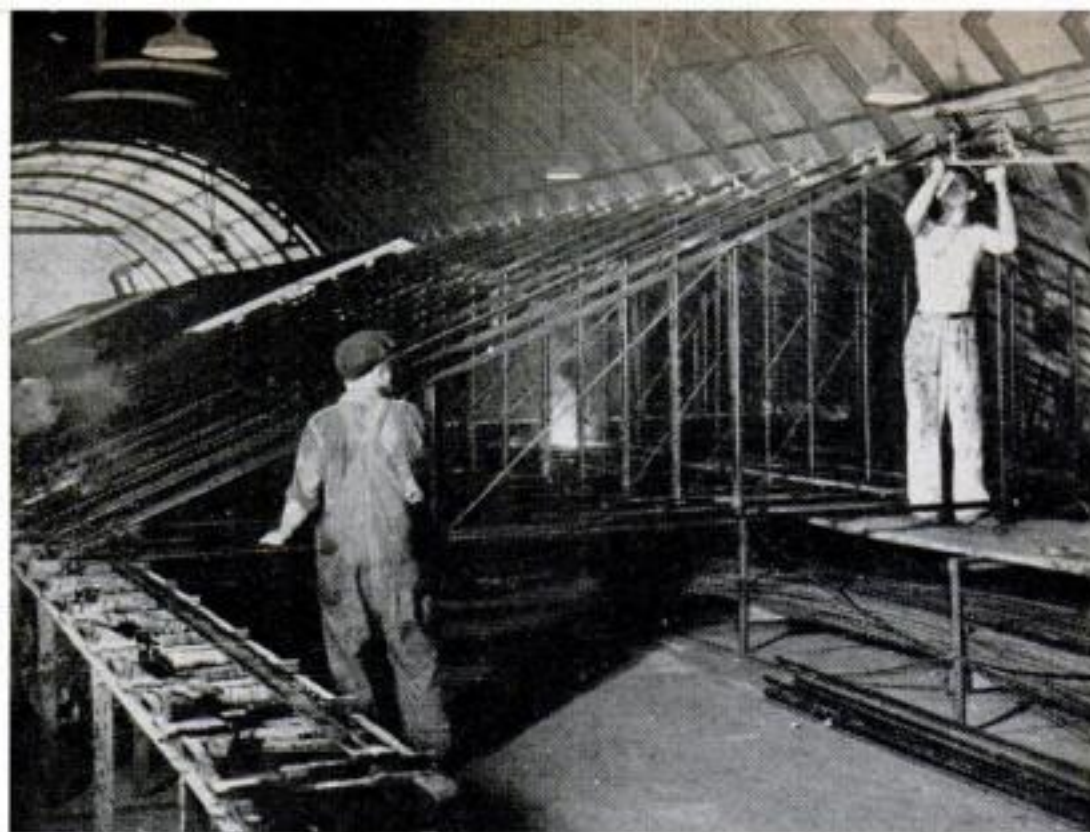


1. At 7:30 a. m., materials are piled high outside shop. Before noon, they will be in a roof. To see how site fabrication builds a house shell in less than four hours, turn page.

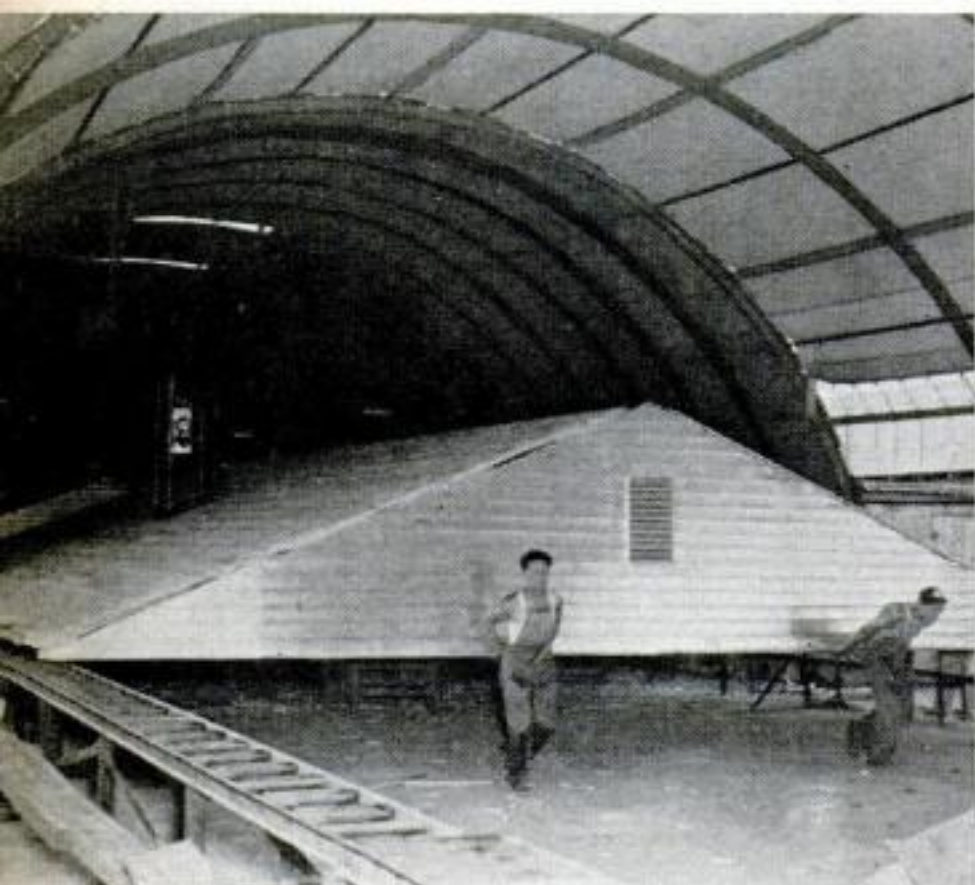




**2. First step** is to lay steel members of roof trusses out on jigs that ensure correct placement in a hurry. Then they are cut to length and welded. The trusses are finished by 8:30.



**3. Now the 20 roof trusses** are set upright, spaced every two feet by jigs, and joined by lengthwise steel beams into a complete roof skeleton. This is welded by 9:30.



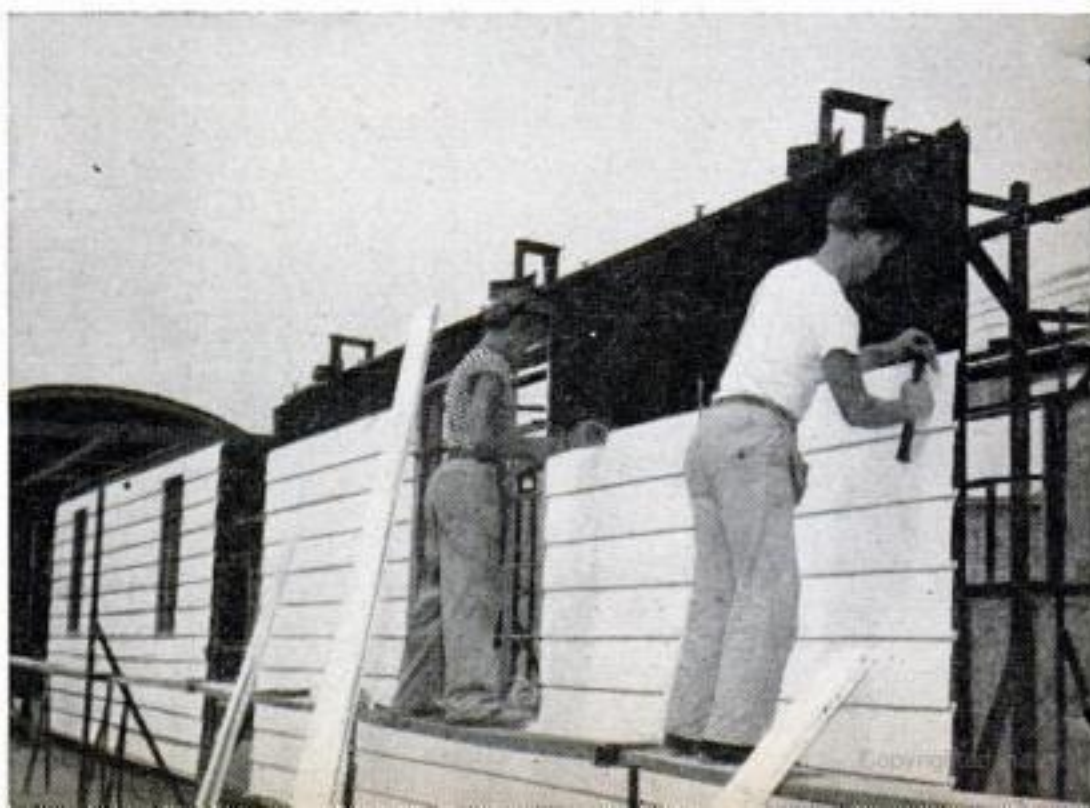
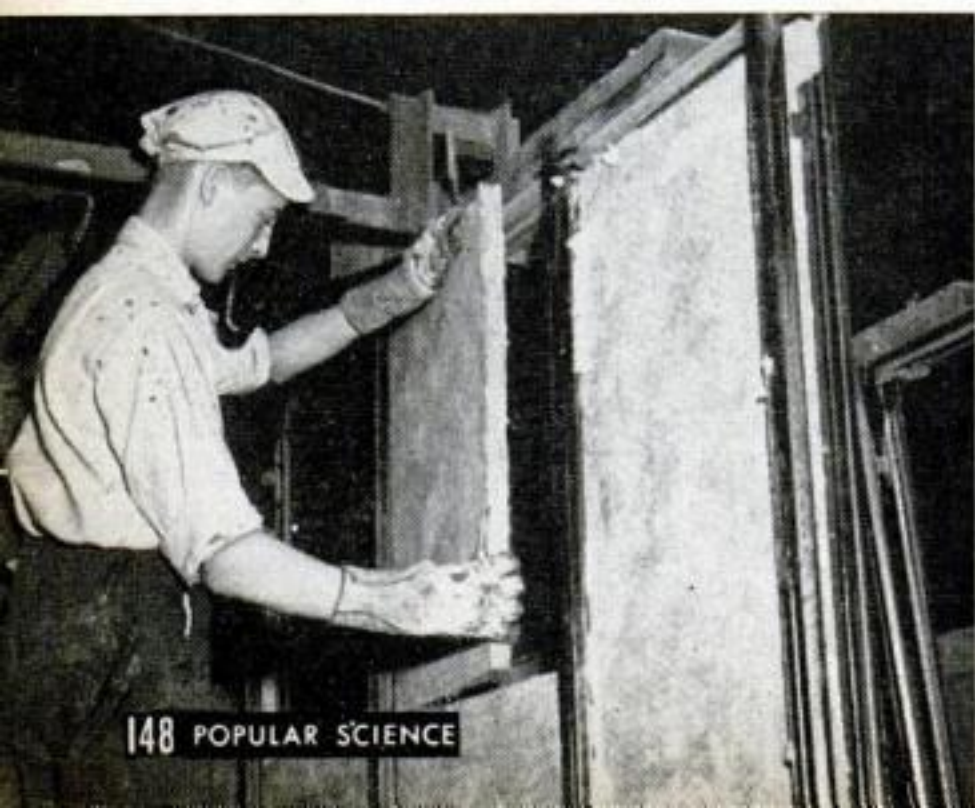
**6. Rolling along the track** seen in the foreground, the sheathed roof is now manhandled up to the next work point. The chimney framework will be lined and covered by cement board.



**7. It takes 10 minutes** more to nail on the roofing paper and another three-quarters of an hour for the asphalt strip shingles. Some houses have aluminum roof. Shingles are on by 11:05.

**10. Fiberglass insulation** is slipped between studs after subassemblies have been welded into wall frames. Window frames and wiring are already in, and wall is ready for siding by 9:35.

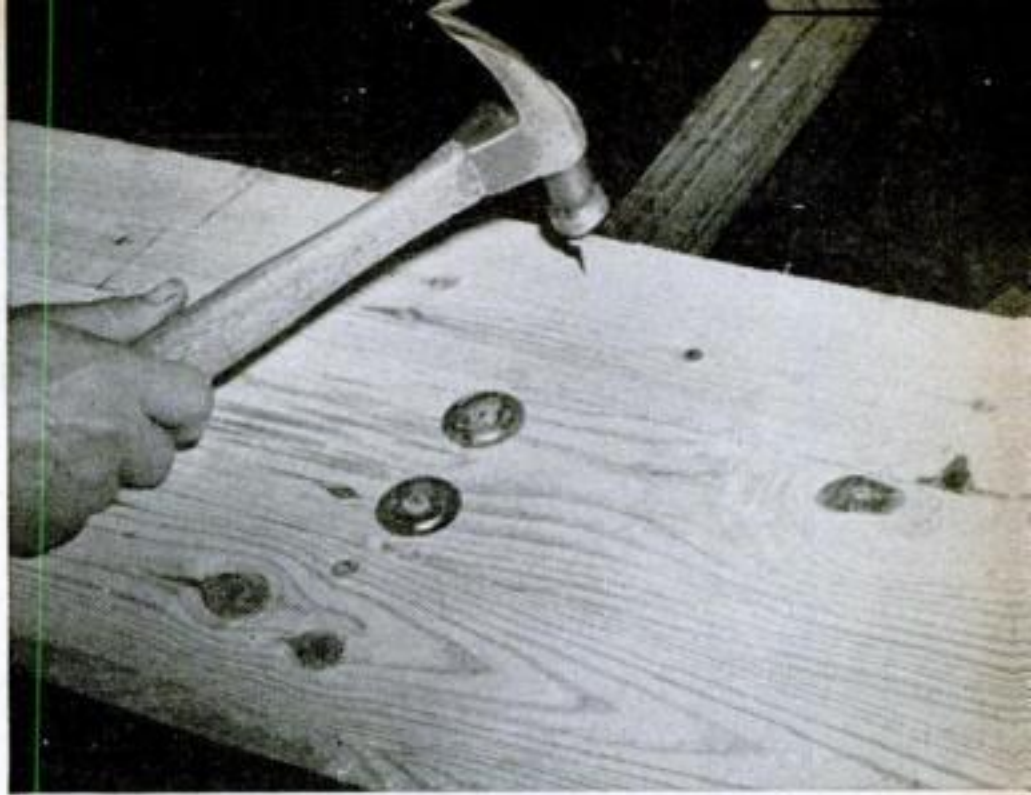
**11. Aluminum siding strips**, interlocked at edges, are now nailed over tar paper to complete the wall. Other siding materials, including stucco, were experimented with earlier.







**4.** The two gable ends are covered with building paper, and aluminum siding sheets are nailed on. Sheets are crinkled to resemble clapboards. The ventilator louver is prefabricated.



**5.** Next the wood sheathing is nailed on. Close-up shows how groove in steel rafter permits board to be nailed to it. V-section inside rafter grips nail tightly. Sheathing is on by 10:15.



**8.** At the end of the line an overhead tackle lifts the 4½-ton roof and a big truck backs under it. It's taken three hours and 50 minutes to build it—and it will be at the site by 11:30.



**9.** Meanwhile, the walls have been taking shape in the shop next door. Here, light steel V-sections are being welded into wall subassembly, finished 20 minutes after shop opens—by 7:50.

**12.** Cross section of a wall shows how the Reynolds aluminum siding interlocks in a tight, galeproof joint. From left to right are siding, steel stud, Fiberglas panel, stud and two coats of plaster.



**13.** Now the completed wall is lifted on the truck that will take all four to the site. From start to finish the walls took three hours and 45 minutes; they are completed at 11:15.



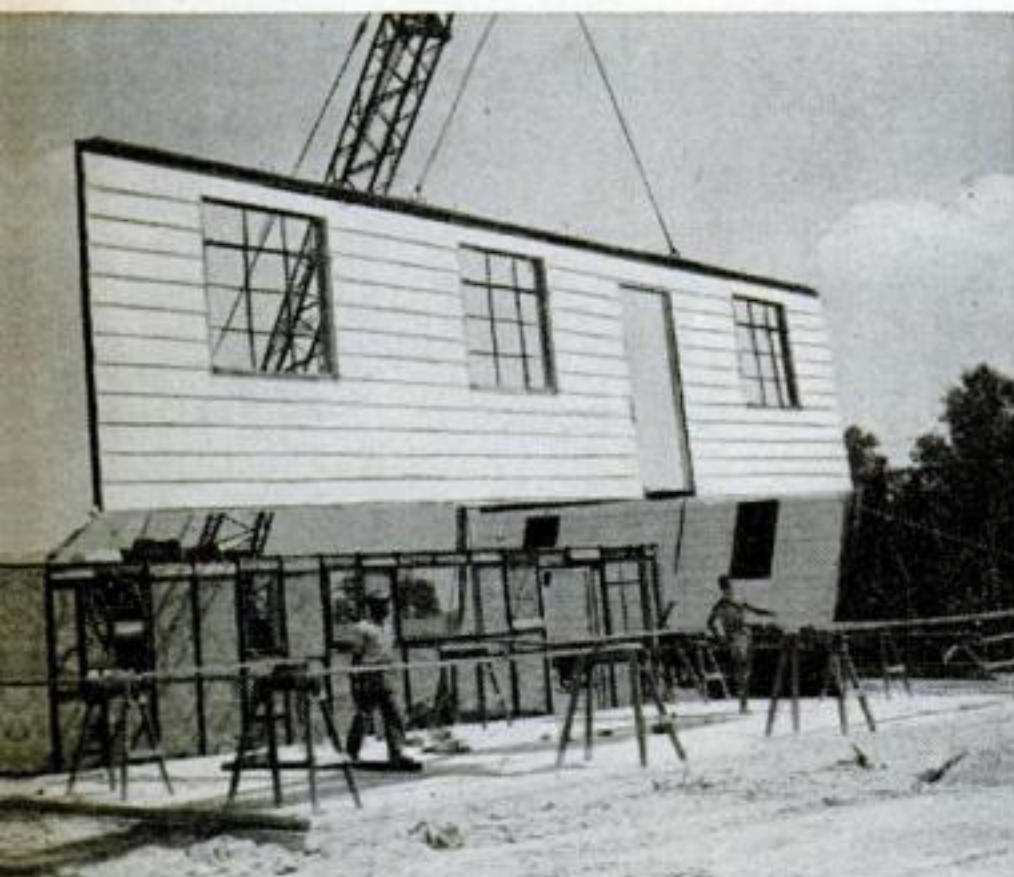




**14. Plumbing and heating pipe assemblies** have been put together days ahead. Here is a main plumbing assembly in its jig. Plumbing takes 1½ hours in the shop, two hours more at site.



**15. On the site** the radiant heating coils, previously assembled in the shop, are joined together and covered with three or four truck-loads of concrete to form base slab.



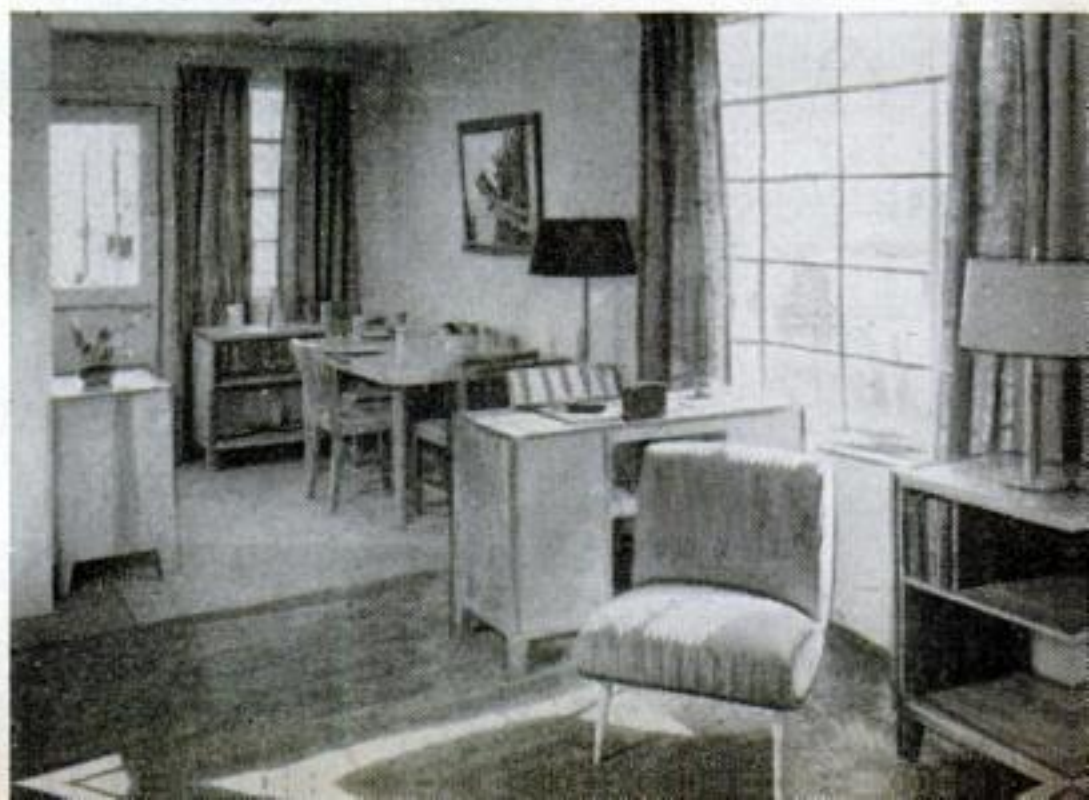
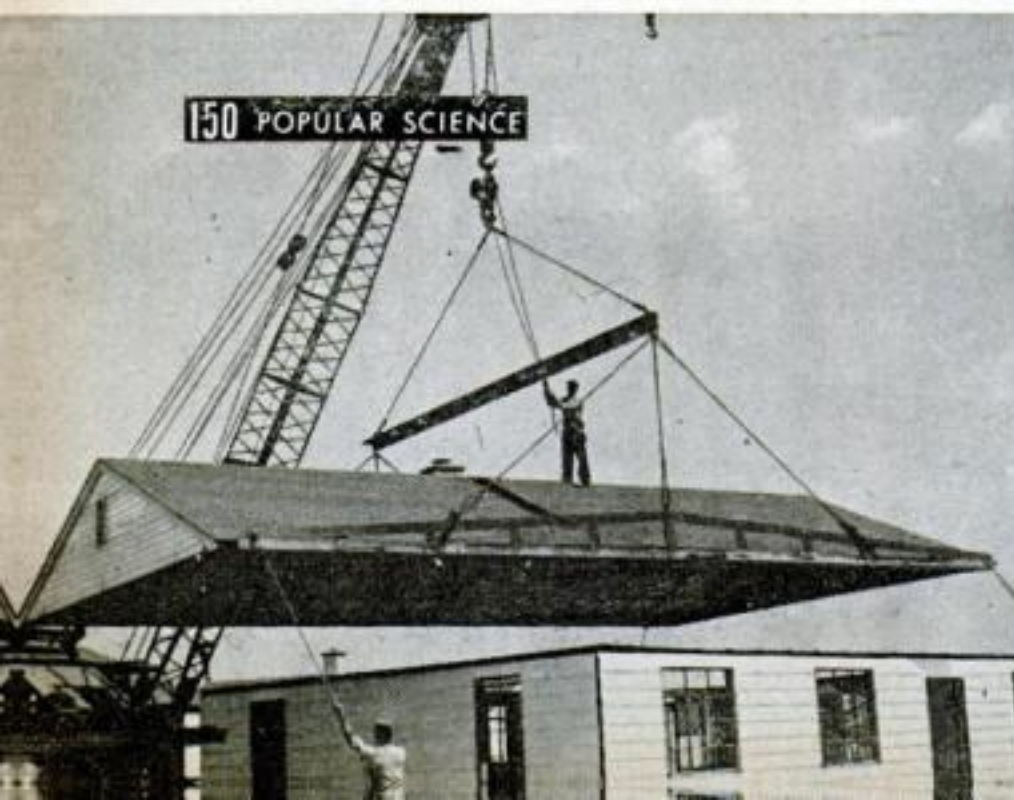
**16. The walls arrive** at the base slab after it has cured for several days, and are lifted into place by a huge crane. Here the second wall drops down as the others wait in the truck.



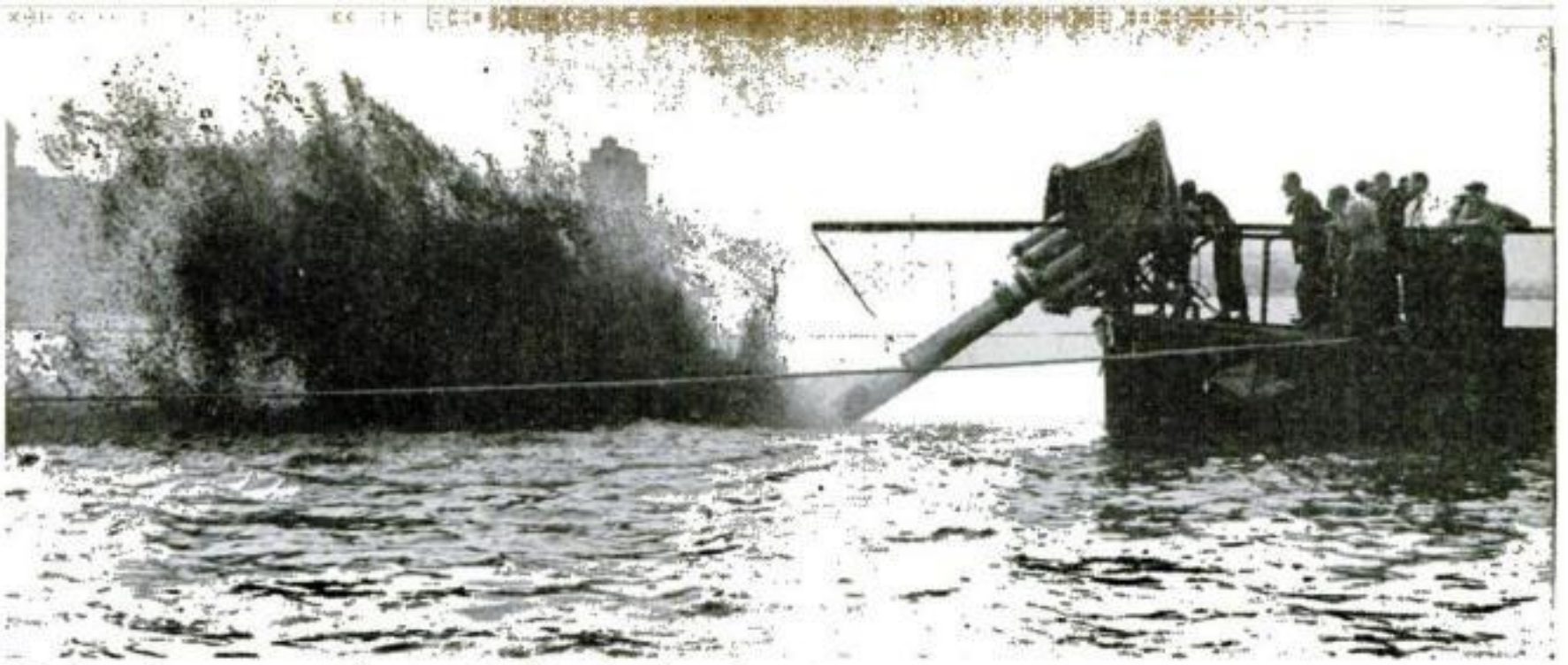
**17. Each wall is bolted** onto the foundation with 34 tie bolts. The cutout piece of insulation will be replaced. Corners of the walls are fastened by wire until they are welded together.

**18. Now a crane** drops the roof onto the four walls. At full speed, a crew puts walls and roof together in 24 minutes, so a house shell started that morning is finished by 11:55.

**19. Interior** of finished house. Walls have been welded to roof and ceiling insulated. Floors are asphalt tile. Houses are scheduled to be completed 21 days after base is poured.







Mud and water are thrown 20 feet in the air as a barge-mounted jet looses its fiery breath at the bottom of the River Thames. Through three feet of water, it gouged huge holes in the muck, dispersing about a ton of it every minute.

## ***Jets Are Jacks Of Many Trades***

**W**HEN already overworked jets aren't pushing airplanes, speedboats or racing cars, they are assigned to less glamorous jobs in Britain.

On the River Thames, dredging experts are experimenting with an aircraft jet engine to blast away dock-blocking mudbanks. If successful, the method may prove less costly and more effective than ordinary dredging.

Also a British innovation is the earlier use of a similar jet engine as a railroad snowplow during winter blizzards.



At close range, the jet's powerful blast routs out a 16-foot-long gash in the bare mud in four minutes. British dredging experts are counting on this new method to help whittle down the estuary's fast-growing mudbanks.

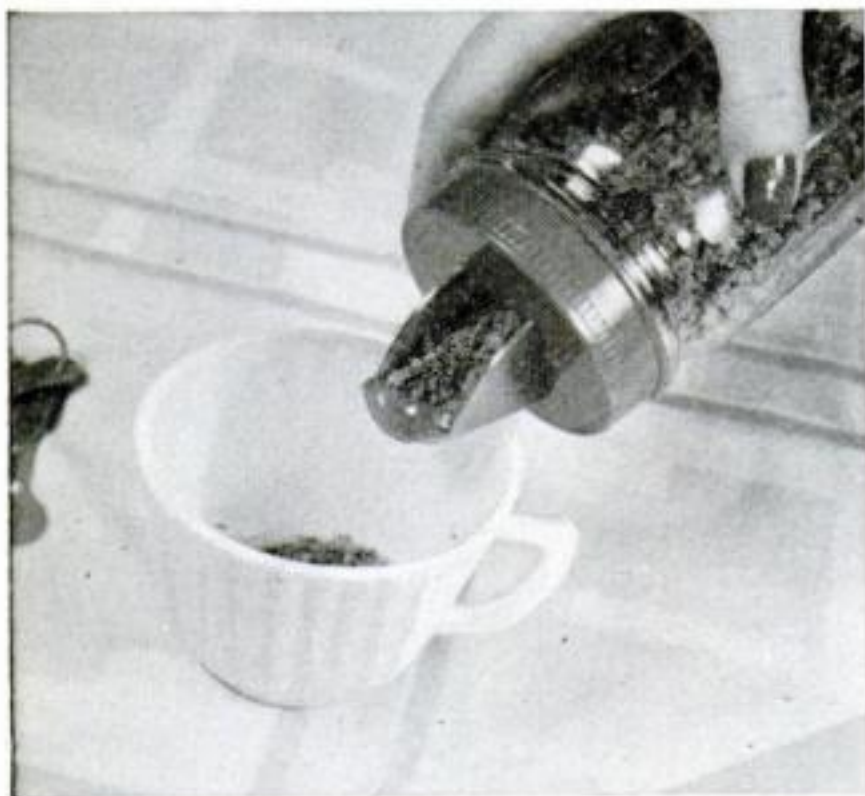


Mounted on a railroad flatcar, another jet makes short work of track-clogging snowdrifts.

Its hot exhaust can clear away 75 yards of snow from 18 to 54 inches deep in five minutes.



## AIDS TO MODERN LIVING



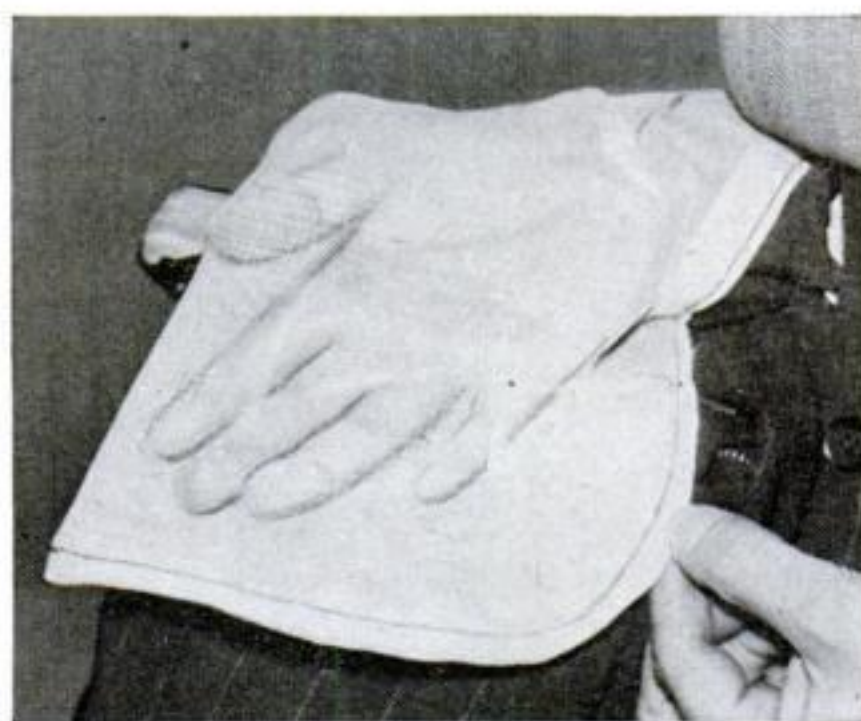
**Cap Has Pouring Spout.** With these new plastic caps, a housewife can make her own canister set from ordinary canning jars. The cap includes a pouring spout which, when not in use, pushes down flush with the top. Made by Jiggs-Penny Corp., New York, the caps sell for 25 cents each.



**Screens Stored on Rack.** Racks on which either screens or storm windows may be stored during the off season are produced by the Barber Manufacturing Co., Minneapolis, Minn. The rack also provides a convenient way of supporting the sashes for painting. Each set holds 21 sashes.

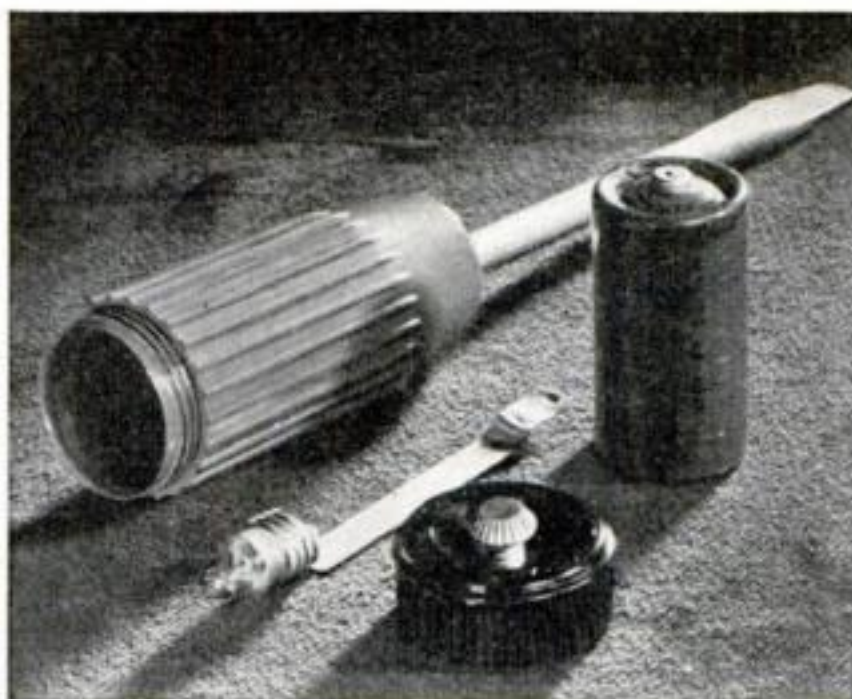


**Dial Adjusts Recipes.** Changing a recipe to produce more or less than the indicated number of servings usually involves a lot of mental arithmetic. The device above, employing a principle long used in engineering, is said to perform such fractional figuring automatically. When you set the dial for the number of servings you want, it shows how much of each ingredient to use. Recipe-Ralph, Hollywood, Calif., makes it.



**Pockets Give Ventilation.** According to Joseph W. Lewis, nylon-mesh pockets like the one above would make men's trousers more comfortable in hot weather. A New York engineer, he contends that the mesh permits circulation of air up the leg, thereby helping keep the body cool. In a demonstration, a thermometer in such a pocket registered several degrees less than another in an ordinary pocket.





**Screwdriver Has Light.** A screwdriver made by the Graham Manufacturing Company, of Detroit, Mich., contains a flashlight in the plastic handle, the light focusing directly on the screw head. The screwdriver blade is easily removable, making it possible to use the handle and light on other attachments interchangeably.

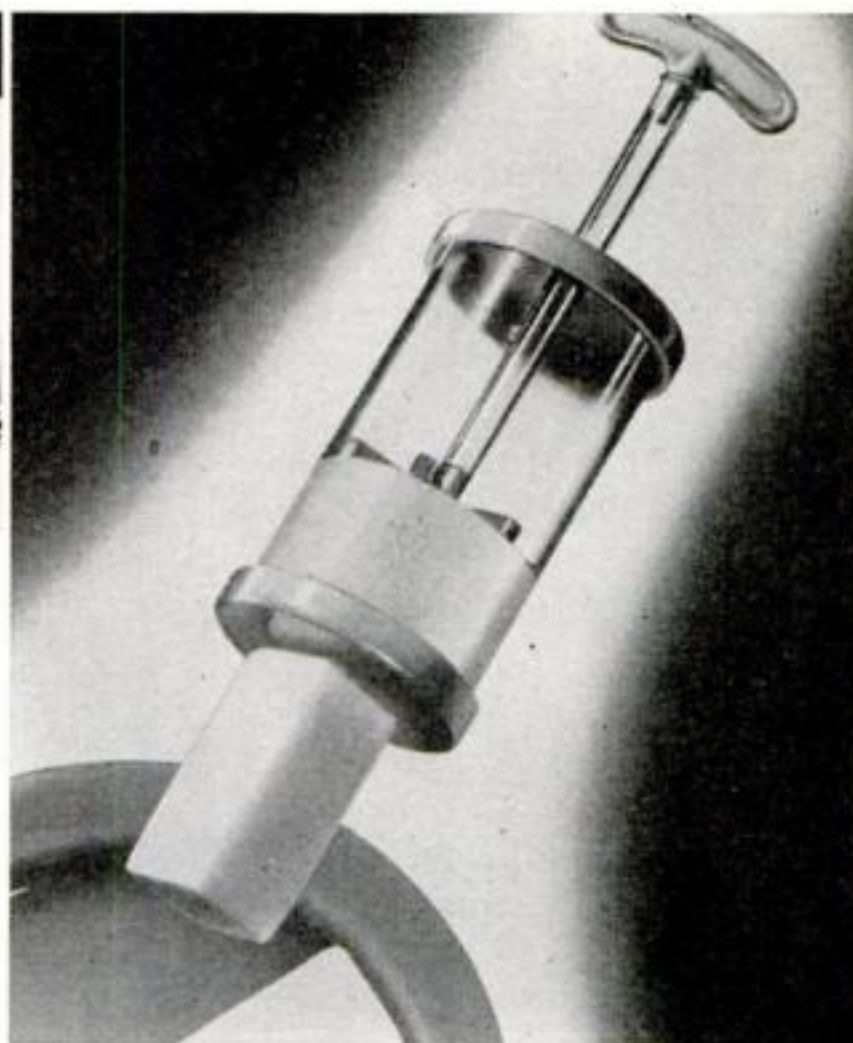
**Bracket Supports Cord.** An ironing aid placed on the market by the Franklin Fader Company, of Newark, N. J., is designed to keep the cord clear of the board while the housewife is ironing. It consists of a bracket that clamps on the wide end of the board and a small weight that is tied to the cord between the bracket and the wall outlet, the cord riding over a small roller on the top of the bracket. The outfit sells for \$1.



**Gadgets Mold Margarine.** Two devices for molding margarine or homemade butter into  $\frac{1}{4}$ -lb. cubes are seen here. Above is a plastic mold into which the margarine or butter may be packed. This is available from the Royal Distributing Co., Kansas City, Mo. At the right is a combination mixer-molder made by Plastic Molded Products, Inc., Los Angeles. After being mixed the margarine is pushed out a square hole.



**Stool Warms Your Feet.** Finished in walnut and upholstered in red or blue velvet, this footstool contains an electric heating element to warm your feet. When the warmer is not in use, the electric cord tucks neatly out of sight underneath the stool. Made by Sherrill's, of Roanoke, Va., the stool sells for about \$35.

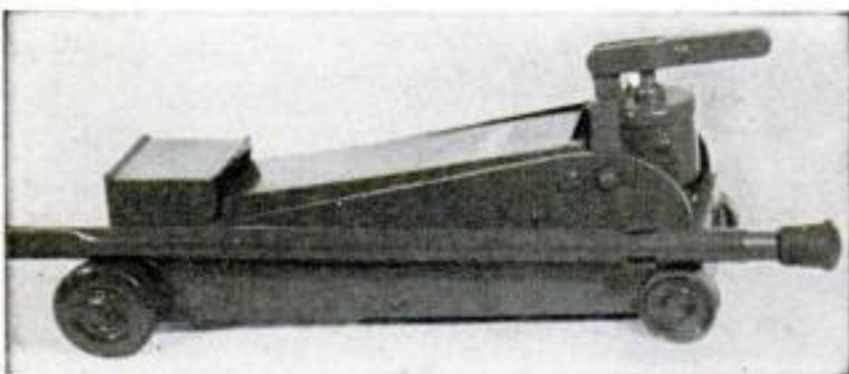




## AUTO IDEAS

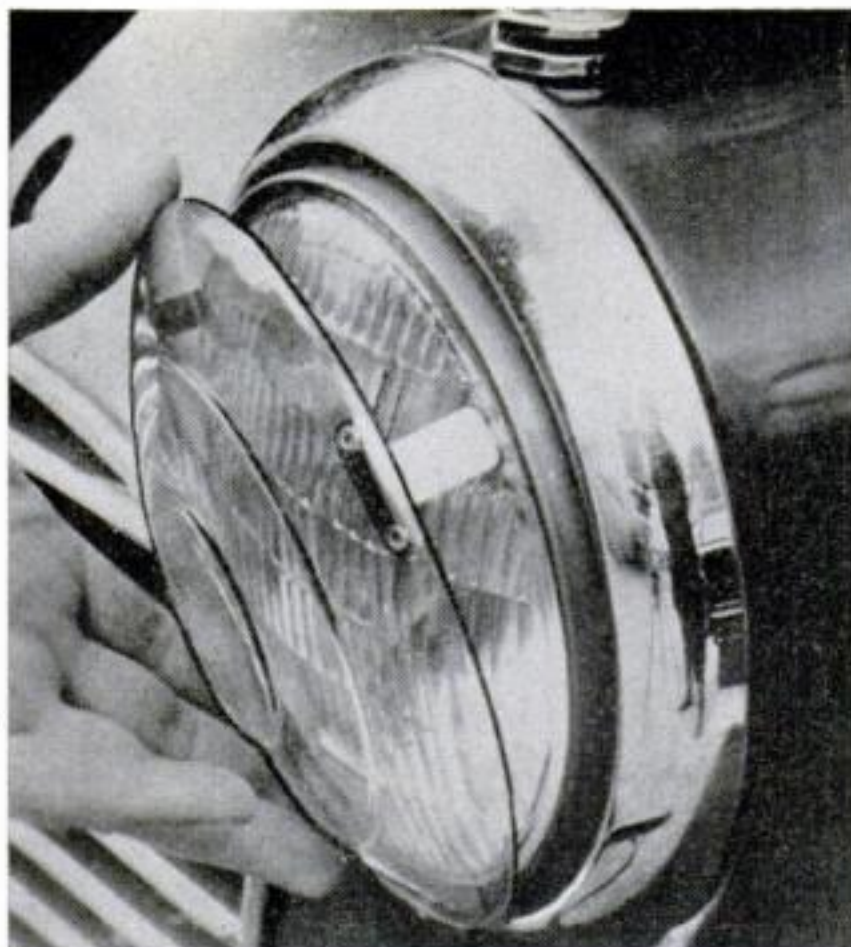


**Eliminates Drafts.** Even though the front window of a car is wide open, a plastic device made by the NuWorld Products Company, Huntington Beach, Calif., deflects the wind outward, protecting rear-seat passengers from drafts. Installed inside the window by three clips, it does not interfere with normal window operation.



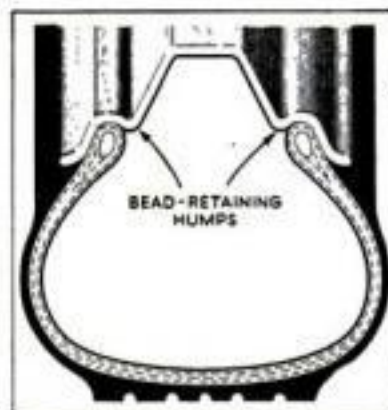
**New Hydraulic Jack.** Easily carried in the car, a new jack made by Zamax Manufacturing Co., Inc., Haverstraw, N. Y., gives the motorist the convenience of the heavy curb jack used by service stations. The detachable handle telescopes to 28" for storage. A key in the handle turns the bleeder screw to lower the jack.

**Absorbs Water.** A product known as Zorbit, introduced by R. M. Hollingshead Corp., Camden, N. J., is designed to prevent frozen gasoline lines. Added to the gas in the tank, it is said to absorb any moisture that is present in tank or line.



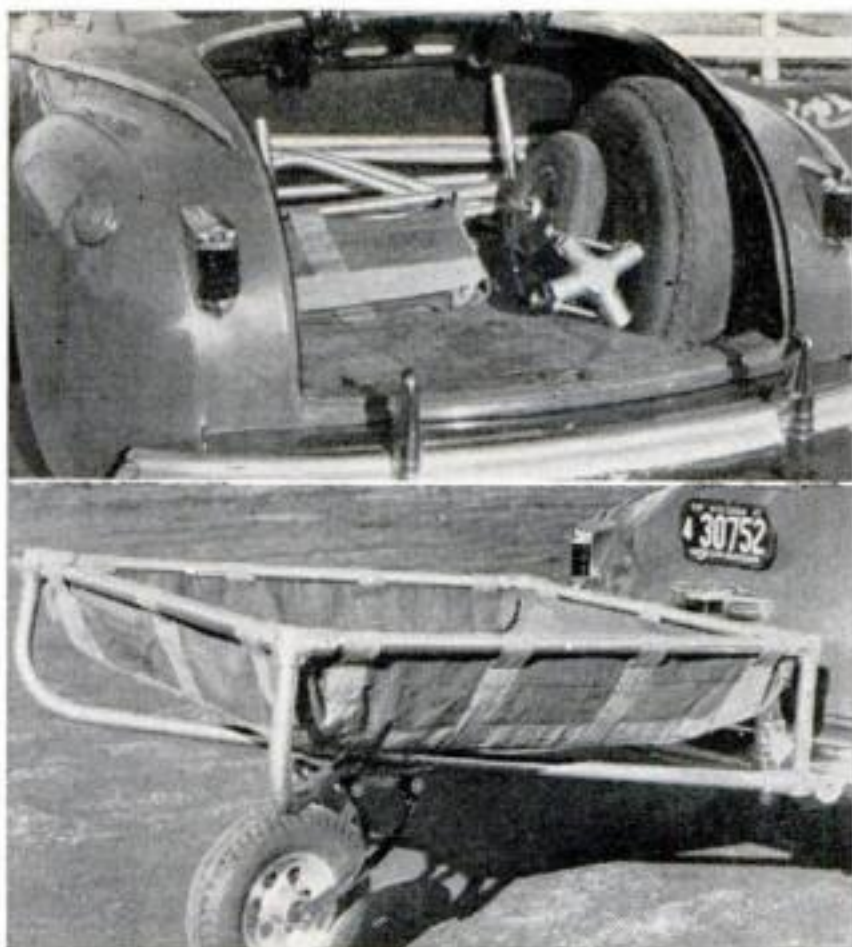
**Fog Lens Clips On.** Standard sealed-beam units may be converted into fog lamps with plastic amber lenses introduced by Hazelite, Inc., of New York City. By means of three clips, the lenses may be quickly installed or removed without the use of tools when the need arises. They are sold at approximately \$3 a pair.

**Rim Is Safer.** A new type of wheel rim introduced on Chrysler-built cars in 1941 but publicized only recently is sketched here. Two barely noticeable humps are designed to keep the bead from slipping into the drop center if a blowout occurs at high speed. Tests have shown that when such a blowout happens, centrifugal force comes into play and the damaged tire acts as if it were inflated. Not until the speed of the car falls to 40 m.p.h. or lower does the tire become flat.

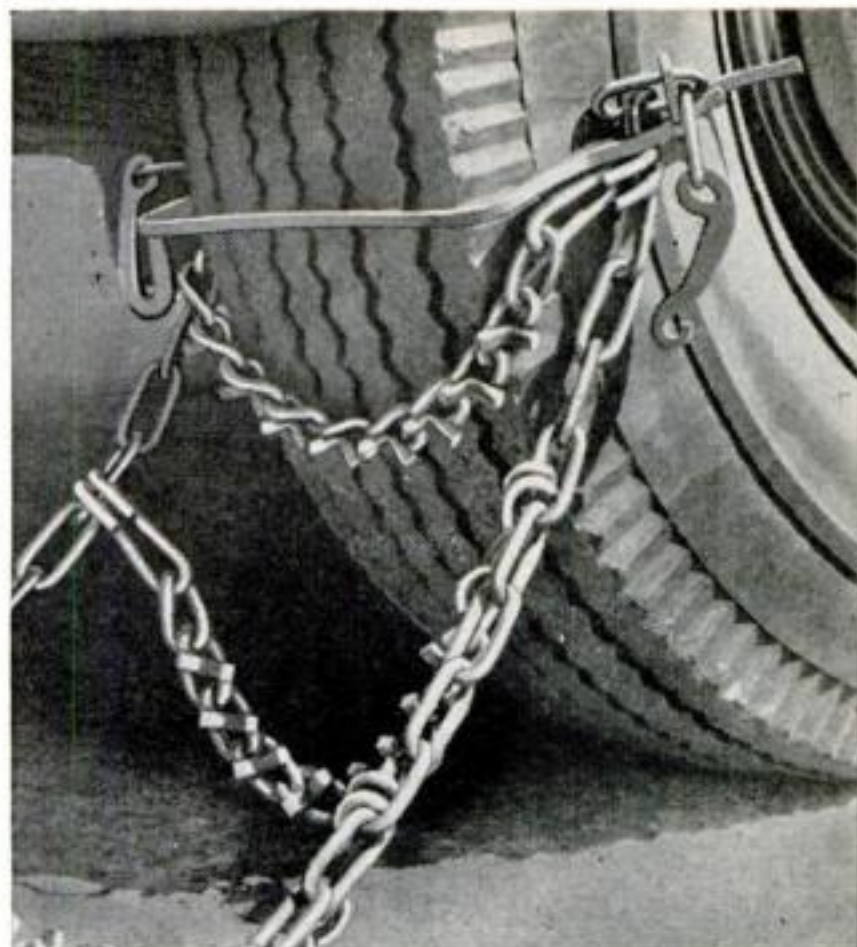


**Cams Lock Battery Terminal.** A new type of automobile-battery connector made by Thomas & Elton Products, Inc., Williamsport, Pa., includes a cap screw that adjusts the connector to the battery post and two cams that then lock it in position, tapers on the cams corresponding to tapers on the two-part connector body. The manufacturer claims that the connector will not "freeze" on the post.





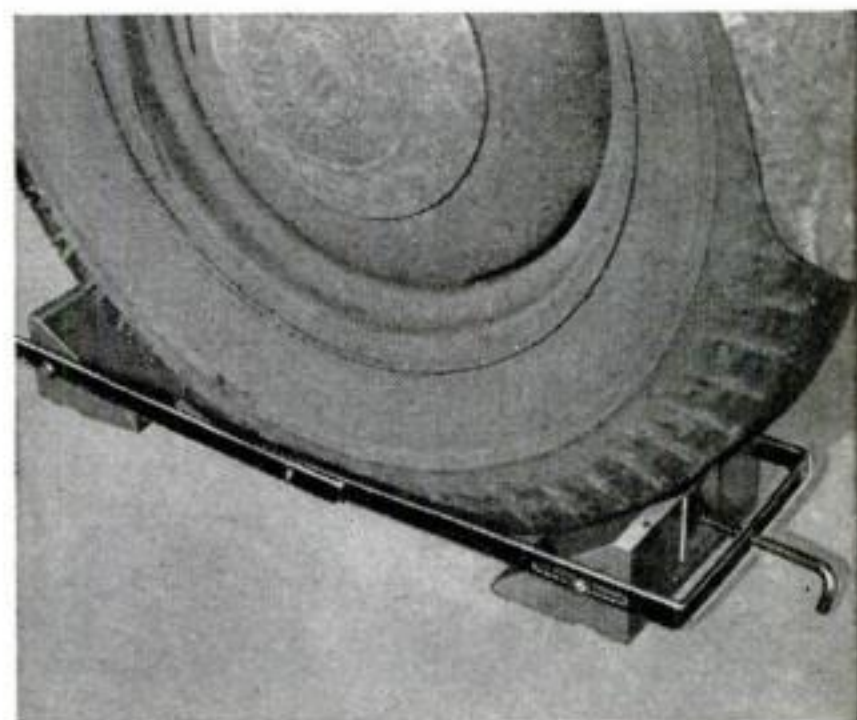
**Trailer Is Collapsible.** A trailer made by Grosch & Gilmore, Milwaukee, Wis., folds up for storage in the car trunk when not in use. Consisting of a canvas body on a tubular aluminum frame, the complete trailer weighs only 45 lb., but will carry a load of 400 lb. It rides on a single pneumatic-tired wheel, mounted on shock-absorbing leaf springs cushioned in rubber. The wheel operates like a caster so the trailer will follow the car. Two ball hitches attach the trailer to the bumper.



**Gadget Helps Put On Chains.** A chain attacher made by the St. Pierre Chain Corporation, Worcester, Mass., is illustrated in use above, with the chain stretched out straight behind the wheel and the U-shaped attacher inserted in the side chains and pushed on the tire. The car then is driven forward until the wheel has made one complete revolution and the chain encircles the tire. After the ends are hooked, the job is done. Also in the photo above are special fasteners\*made by the same company.



**Warns That Brake Is On.** A new Ford accessory gives audible warning if you start out without releasing the hand brake. Vacuum operated, it consists of a whistle, a hose and T-shaped unit for connecting to the wiper vacuum line, and a spring to hold the whistle open while the brake is set. It blows only when the engine is running.



**Device Blocks Wheel.** An adjustable chock introduced by Modern Devices, Inc., Chicago, Ill., prevents a wheel from rolling in either direction. It consists of triangular wooden blocks held together by a metal frame, one block being removable so it can be set in place. A screw tightens the blocks. The frame folds for storage.



# Rivetless Brake Linings Last Longer

**I**F YOUR car should require new brake linings, there is a good chance that the mechanic may suggest bonding them to the shoes, for an increasing number of repair shops are offering such service. By this relatively new process, linings are cemented and heat-bonded on the shoes, eliminating the traditional rivets. Bonding procedures announced by three companies are illustrated here.

According to the Goodyear Tire & Rubber Company, linings installed by its Uni-Bond process can be expected to last twice as long as those that are riveted, since the lining may be worn down to the shoe instead of only to the rivet heads. In addition, elimination of rivets increases the braking surface and lessens the possibility of brake-

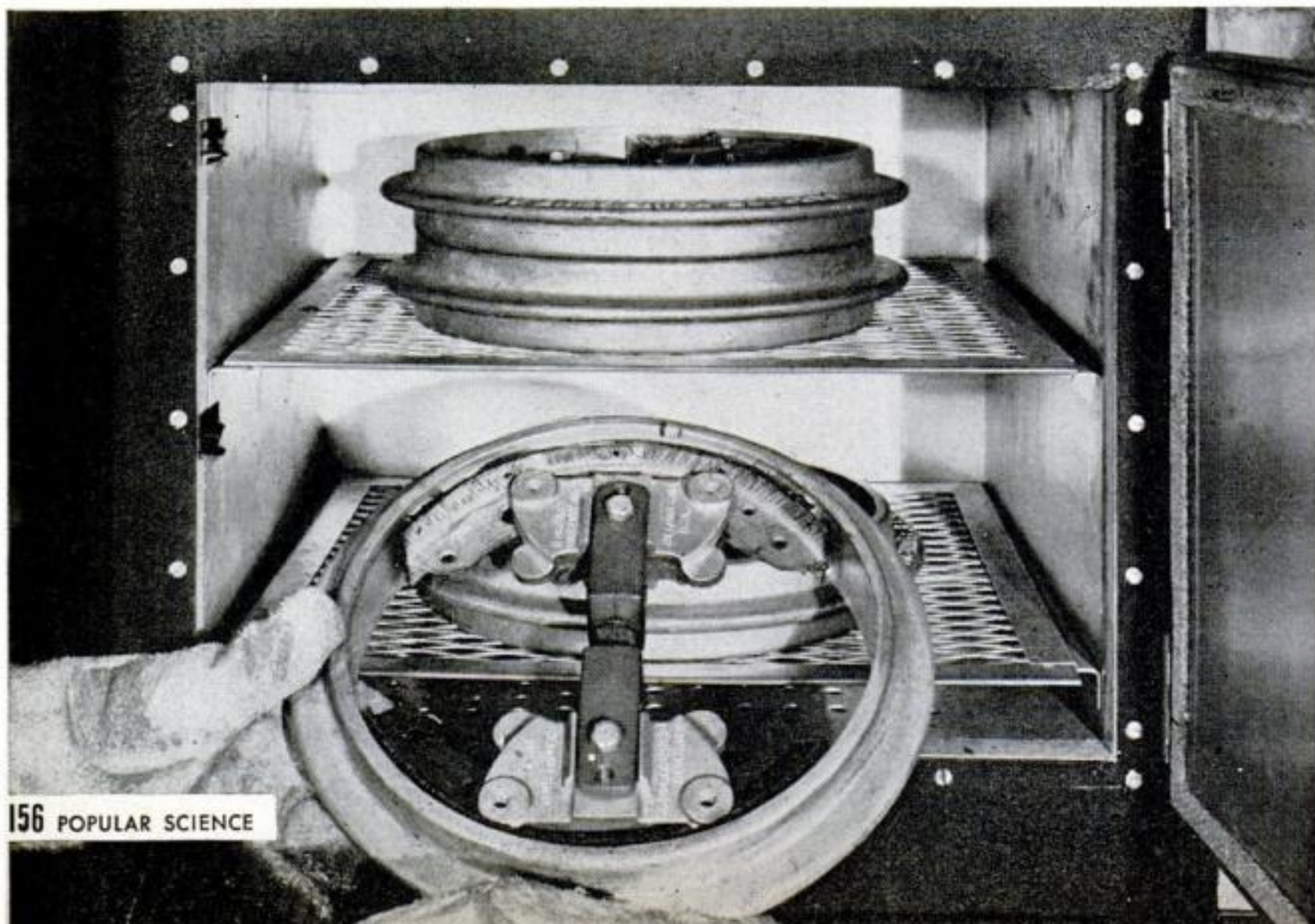


**Buffing the shoe** to remove dirt, rust, and oil is the first step. A clean surface is needed for a good bond between the lining and shoe.

drum scoring, frequently caused by abrasive material collecting above countersunk rivets.

Thorough cleaning of the shoe face is the first step in any bonding process. In the Goodyear process, cement then is applied and allowed to dry for 20 min., after which lining and shoe are forced together by a specially designed pressure ring and placed in an oven for a specified time. Another bonding method shown here has the cement preapplied to the lining, and a third provides it in strip form that is cut as needed.

**Locked in a ring under great pressure, the linings are placed in an oven for 20 to 30 min.**



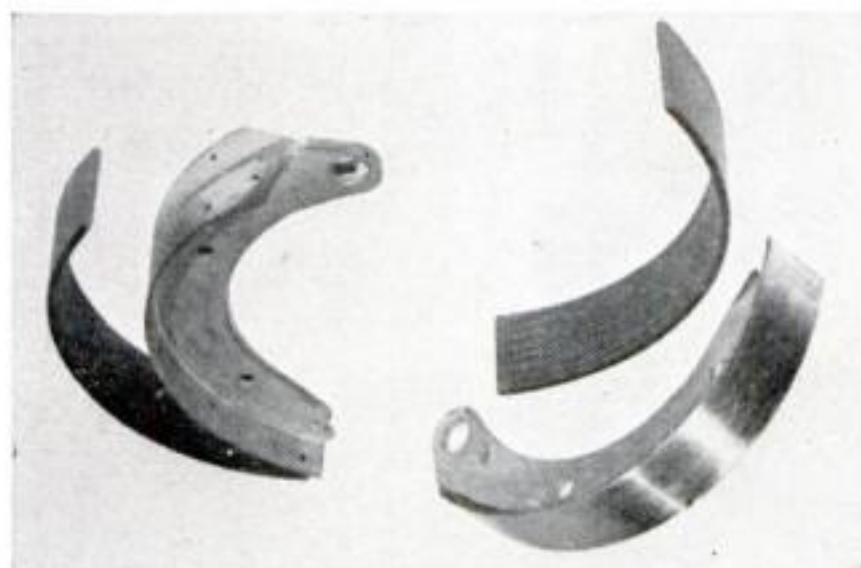




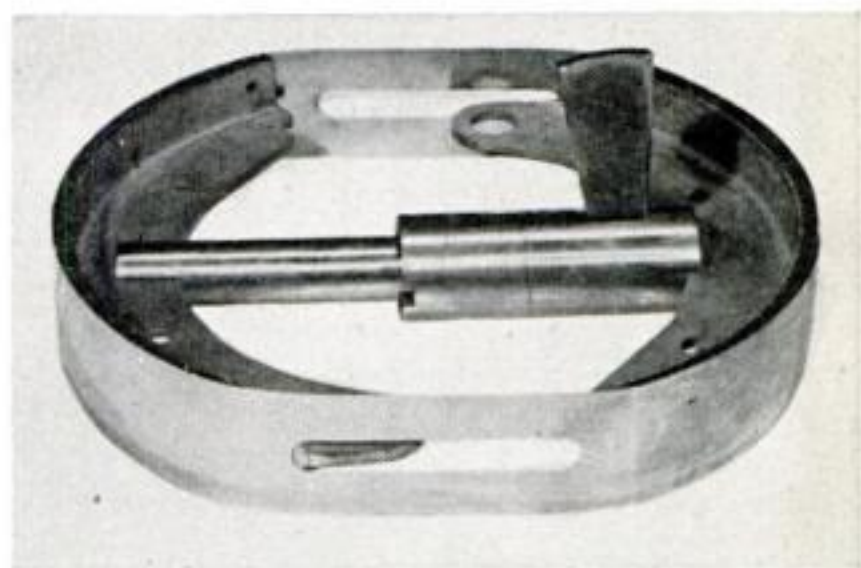
**Special cement** is applied to the clean shoe, left to dry for 20 min., and lining and shoe are then forced together in a pressure ring.



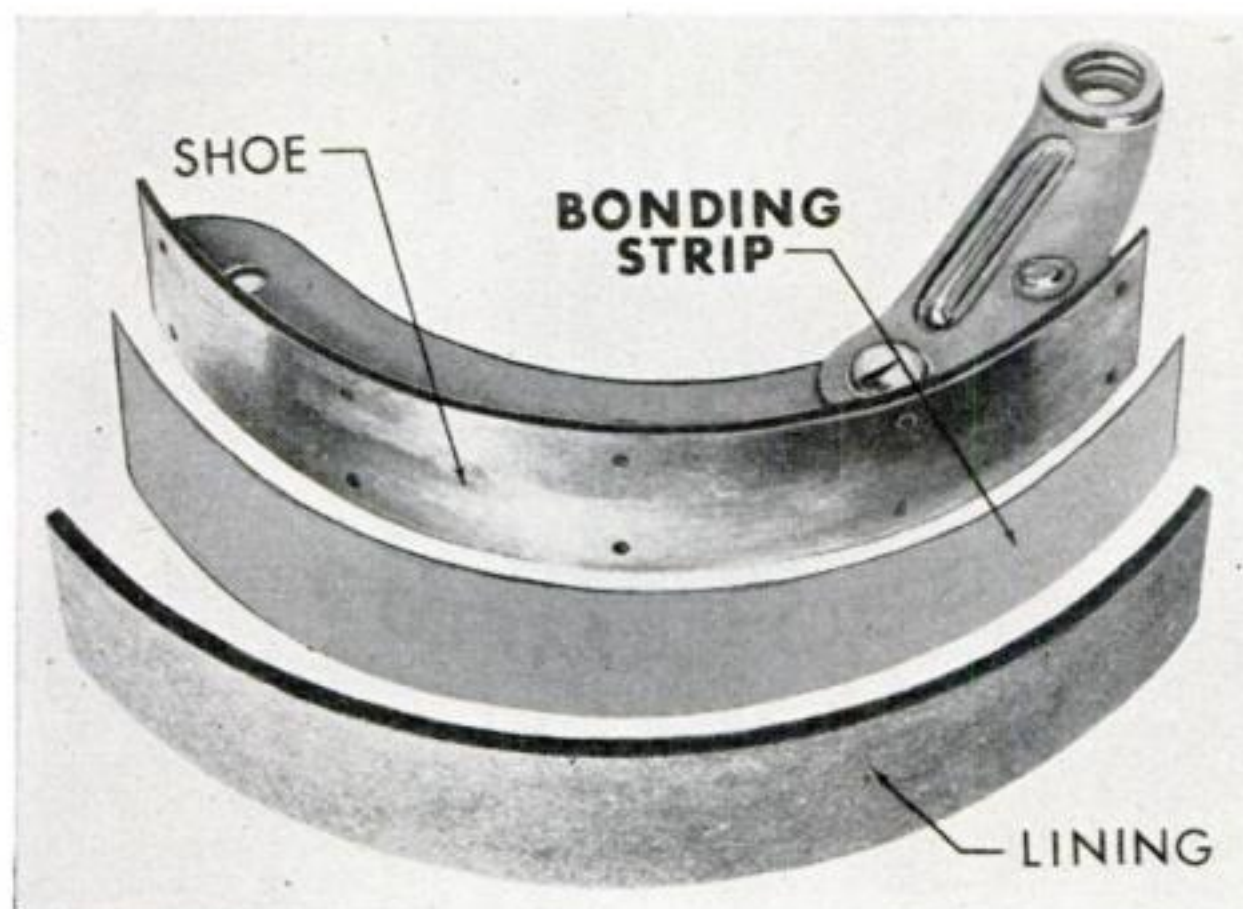
**After baking**, the lining and shoe have become one unit. Such linings are said to withstand shear pressures of 1,400 lb. per lineal inch.



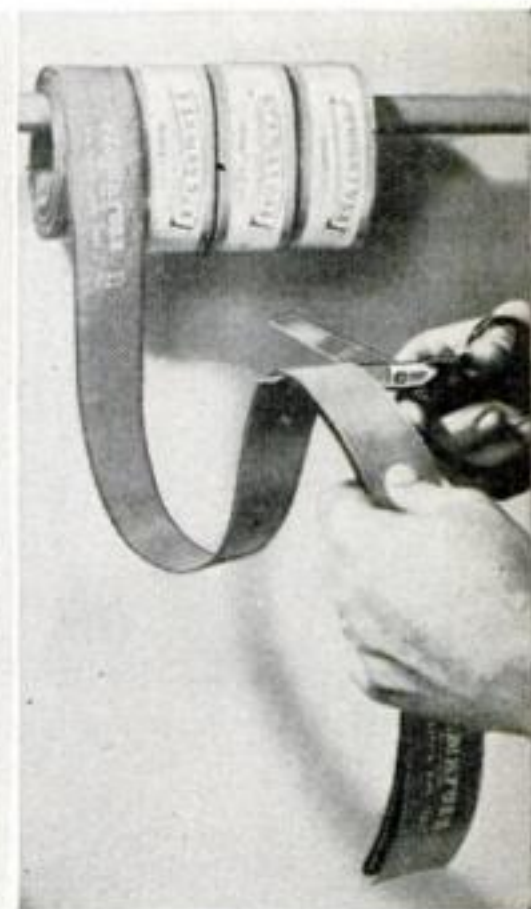
**Lining segments** developed by the Grizzly Mfg. Co. come with the bonding agent preapplied.



**Pressure rings** are of several types. Here a tapered key exerts pressure when driven home.



**A bonding agent** in strip form is made by the Permafuse Corp., Brooklyn, N. Y. When heated,



it bonds the lining to the shoe. Lengths to match the lining may be cut from the roll.



# Curing Auto Door Ailments

By Frank McCarty

CAR doors are usually the first things to give trouble when a body begins to wear. They have to be slammed to stay shut. Hinges become sprung. Window glass will not raise and lower easily or far enough. Rattles distract the driver, and latches that hold doors insecurely invite injury to passengers or passers-by. Balky locks cause delays and expose one to weather.

Preventive maintenance on doors, as on other parts of a car, saves hours of bother. It consists simply of regular lubrication. However, when something does go wrong, correct it without delay. How the most frequently needed repairs are made is shown in the photos on this and the facing page.



**Stiff lock action** or the danger of its freezing in winter can be prevented by a squirt or two of powdered graphite from a spray-type dispenser.



**Door handles** of this type are removed by loosening one setscrew in the edge of the door. Once out, the handle can be disassembled and the lock barrel removed if it should require adjustment, repair, or replacement.

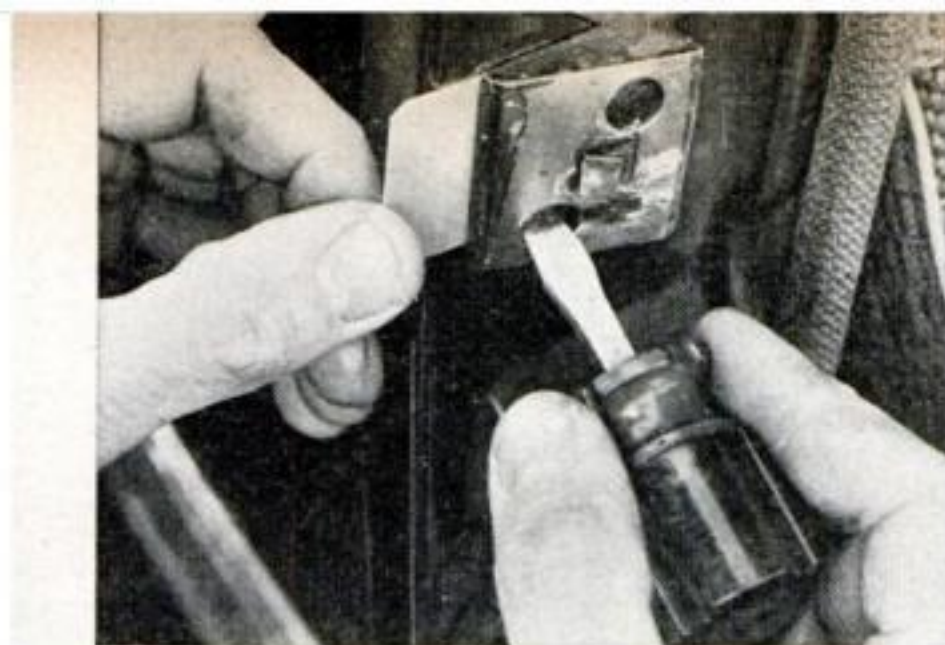


**Separate lock units** located under the handle are also held in place by one setscrew. When a lock barrel of this type is being replaced, a wire is inserted through the setscrew hole to help guide the square shank into the lock. Be sure to turn the setscrew down flush when it is put back.



**Jamb strikes** require lubrication with stainless graphite, which may be had in the convenient pencil shape. The strike shown has rubber insets that can be replaced by removing the two screws.

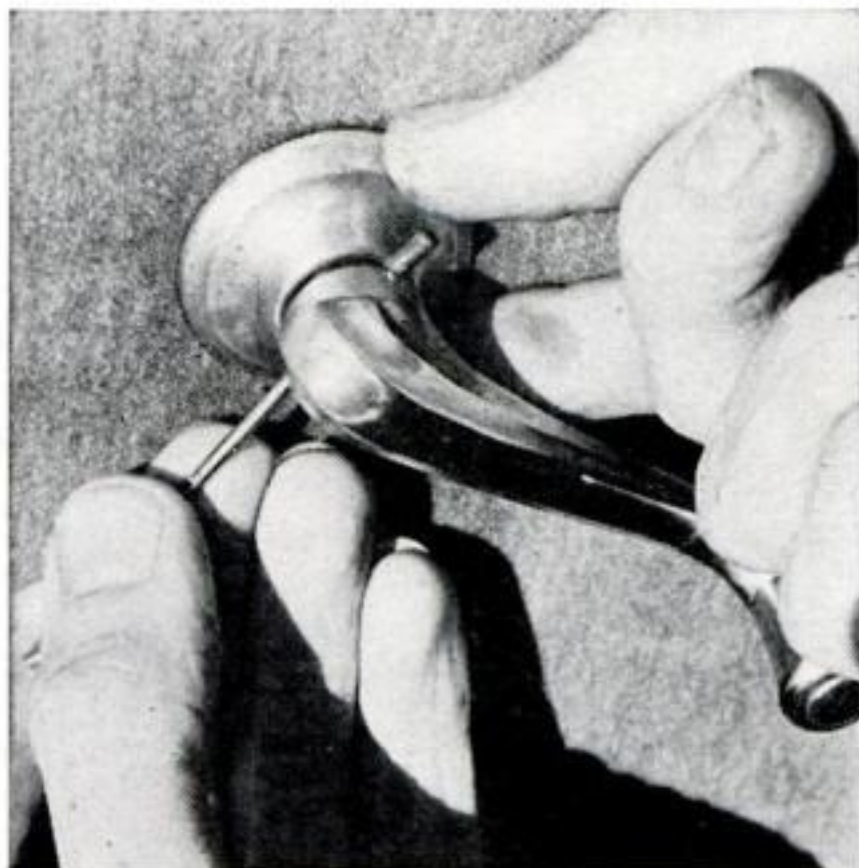




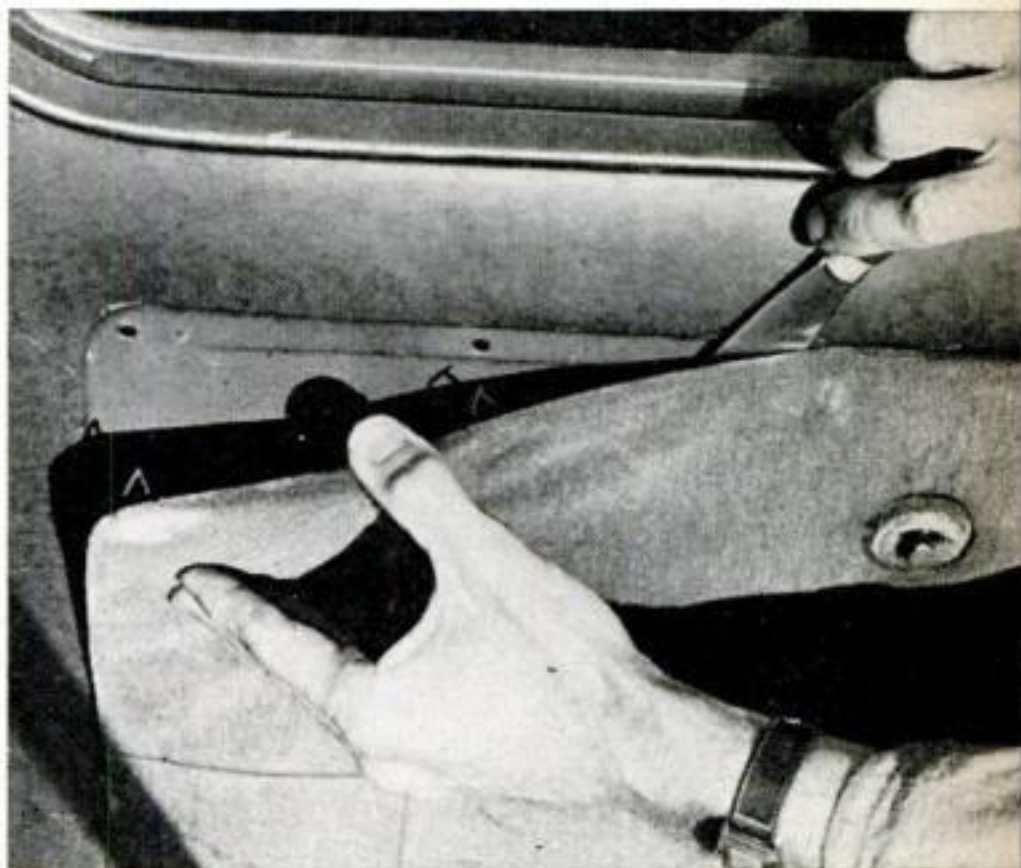
**Worn-down latches** are adjusted quickly with a metal shim set in behind the strike. Loosening the screws will permit inserting the shim.



**Concealed hinges** are oiled from the inside of the open door. Close examination will usually disclose an oil hole in the hinge.



**Inside handles** are removed by depressing the escutcheon ring and pushing out a pin or clip. The handle is then slipped off the shaft.



**Upholstery panels** can be pried off with a wide putty knife. Press the blade against the spring clips or nails to avoid ripping the material.



**Lifting mechanism** is revealed with removal of the door panel. Scrape dirt and grease off the rails and relubricate with a graphite pencil.



**Removal of the mechanism** is possible after lowering and taking out the glass. The spring on the gear at right acts as a counterbalance.



# Gus Spots Double Trouble

Anyone could see the fuel mixture was too rich—but why? Cleaning and adjusting the carburetor made no difference.

**By Martin Bunn**

STAN HICKS nudged his employer. "Here's Old Man Trouble himself!" he said. Gus Wilson looked up. The driver was just getting out of an old but well-kept sedan he'd stopped in the center of the Model Garage shop floor. His thin face was creased with chronic dissatisfaction.

"Hello, Vern," Gus greeted him cheerfully. "Haven't seen you for a dog's age. Where've you been keeping yourself?"

Vernon Hopkins almost shouted. "There never was a time when a man got as little for his money as he does today. Look at my car. I've had it in three shops—and there's still something wrong with it."

He had left the engine running. Gus noticed black smoke drifting out of the exhaust pipe, and his nose detected unburned gasoline. "I don't know what else is wrong with your bus," he said, "but your carburetor is certainly out of adjustment."

"Now, ain't you smart!" Vern's voice dripped mock admiration. "All three of those boneheads who worked on my car figured out there was something screwy about the carburetor—but not one of them had any idea what the trouble is. And I'll bet you can't find out either."

"What'll you bet?" Gus challenged.

"Anything you want," Vern growled.

"Okay," Gus said. "Tonight's supper."

"Well—all right," Vern agreed. "Now what are you waiting for? Find out what's wrong—and fix it. I'm in a hurry."

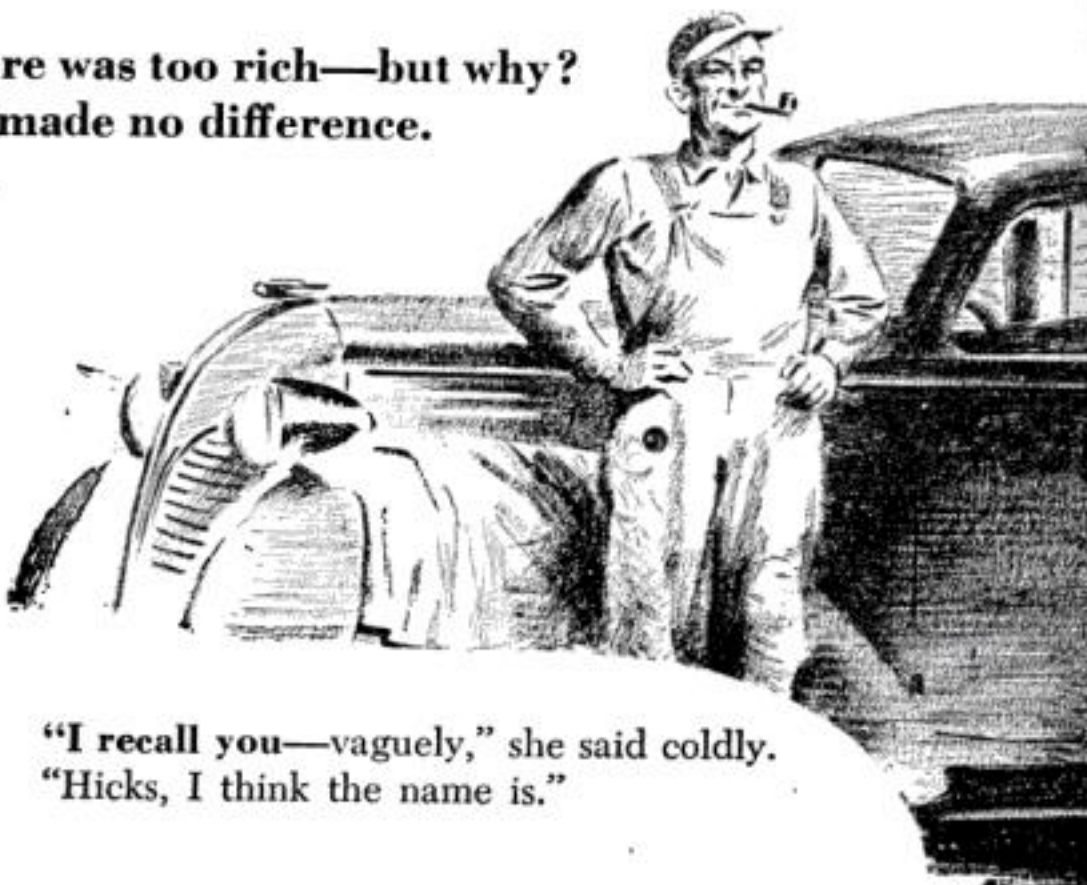
"You're not our only customer—thanks be!" Gus replied. "Three other jobs came in ahead of yours—and will have to go out ahead of it. Come back at four o'clock. I'll have your bus ready."

"Four o'clock!" Vern howled. "What am I supposed to do until then—walk?"

"It'll do you good," Gus said.

Vern stalked out.

**B**EFORE Gus got to Vern's car it was nearly two o'clock. Then he took it out for a road test. After driving slowly for a



"I recall you—vaguely," she said coldly. "Hicks, I think the name is."

few blocks he suddenly stepped hard on the accelerator. The engine choked and missed. Keeping the accelerator pedal down, he threw out the clutch. Instead of speeding up, the engine continued to miss and sputter. "Carburetor out of whack, all right," he thought, as he turned back toward the Model Garage. Before he got there the engine was beginning to overheat. "Just what I thought—too rich a mixture," he told himself.

He drove into the shop and sat for a few minutes listening to the engine's noticeably rough idling. Then he switched off the ignition, removed the carburetor, carried it over to his bench, and opened it.

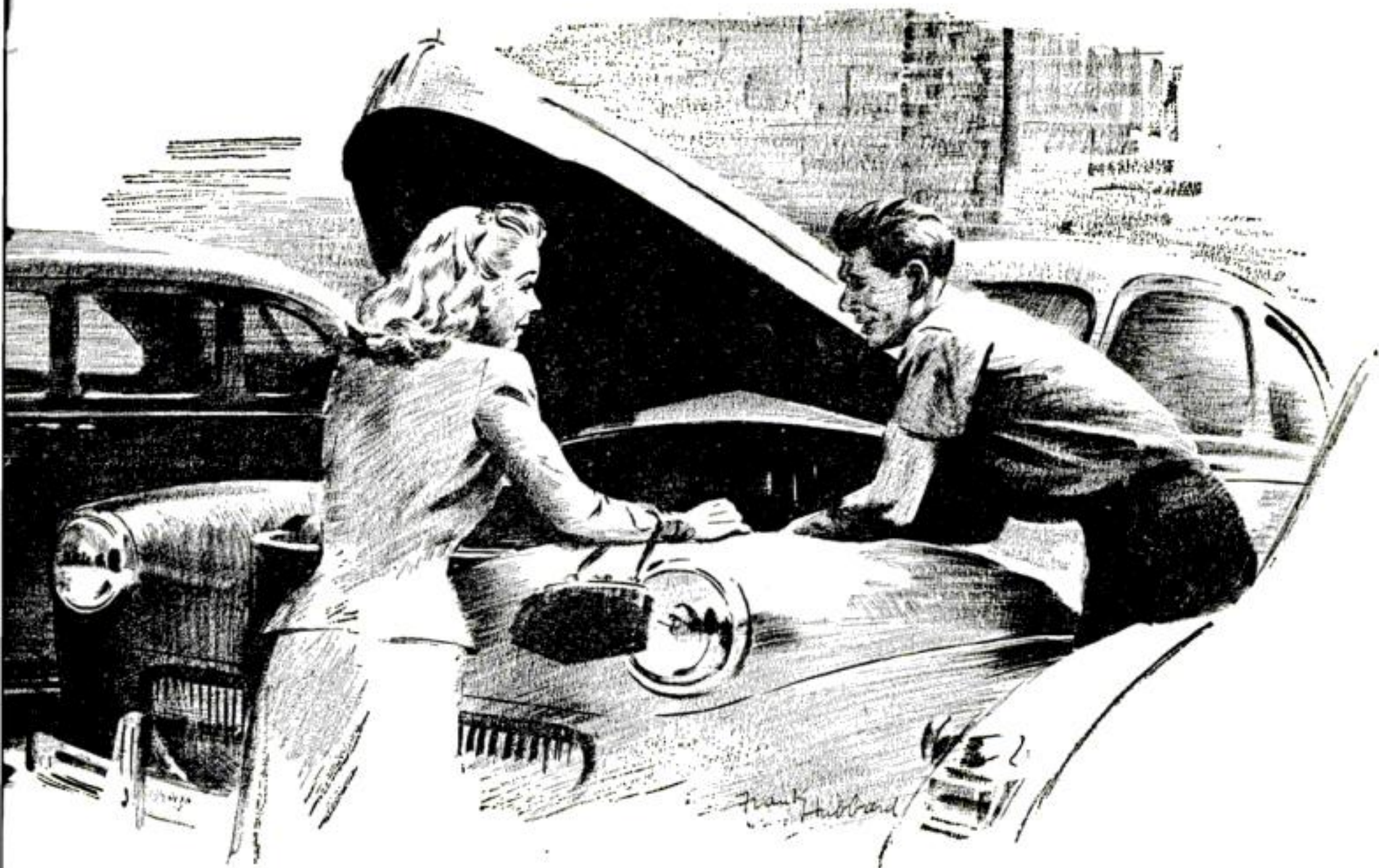
It was one of those carburetors that have the float, hinge mechanism, and needle valve all mounted on the upper body, the latter in turn being mounted, over a gasket, on the bowl.

Disassembling the carburetor, Gus set to work to clean all the parts. As he did so, he checked each carefully, giving the float particularly close scrutiny, but found nothing either damaged or badly worn. So, after blowing out the passages and jets with compressed air, he reassembled the carburetor and put it back on the car.

Just as he finished, his partner Joe Clark called from the office door. "Hey, Gus! Mr. Morgan is here about that motor-rebuilding job. Come in, will you?"

Gus looked at the shop clock. It was al-





most three. He wanted to have Vern's car ready by four, and the chances were that Mr. Morgan would take a half hour.

"Stan," he said. "Take out this Hopkins job and road-test it. I've cleaned and checked the carburetor, and it should be all right—but make sure."

Gus was back in the shop when Stan drove in, shaking his head. "Somethin' still wrong," he reported. "The engine doesn't run like it ought to, and it overheated."

He could add nothing to that report. Now thoroughly puzzled, Gus jumped into the car and drove out.

The engine acted just as it had before. He hurried back to the shop and quickly checked the ignition and fuel line, but there was a good hot spark at each plug and the gasoline flowed normally. "Must have missed something," he muttered, and again removed the carburetor, disassembled it, and began rechecking.

Half way through the job he was interrupted by a feminine voice that asked crisply: "Is my car ready?"

Gus looked up. The young woman's costume nicely set off an effectively streamlined chassis, and her pert face expressed determination to have what she wanted.

"Your car?" Gus asked. "Do we have it?"

"My father's," she snapped. "I'm Miss Hopkins."

Stan raised his head from the car on which he was working. "You don't mean you've grown up from that little Susie Hopkins who tried out for cheerleader in her freshman year—and didn't make it!"

The girl turned and leaned against the car. Smiling acidly, she looked Stan over with the expression of a scientist who has just discovered a new, but uninteresting, species of insect.

"Looking back at that horrible high school," she said coldly, "I seem to recall you—vaguely. Hicks, I think the name is. You were on the football team, and it was your fumble that let Millbridge High beat us for the first time in 13 years."

Stan's ears got red. "The wind—"

"The wind—" she mocked, making a derisive gesture with both hands. Then she turned back to Gus. "What I want to know is—is my car ready?"

"Nope," Gus replied.

"But Dad said you'd promised to have it ready by four!"

Gus nodded toward the clock. "It's only twenty to four."

"I'll wait, then," she said, perching her-



**Black smoke** came from the exhaust and there was an odor of unburned gasoline.



self on the end of the bench. "What's the matter with the old wreck?"

"Carburetor," Gus said.

"Again?" she asked. "I haven't heard anything but 'carburetor' ever since Dad put that new gasket on it."

Gus looked thoughtful. "So your father did that job himself?" He examined the soft fiber gasket carefully. Then he placed it on the bowl and fitted the upper body of the carburetor over it, bringing the drop light closer so he could see better.

"There's nothing wrong with the gasket or its fit," he said after a moment. He lifted off the upper part of the body. "It's all—" Gus abruptly stooped over and whistled softly. Then he removed the gasket and took the bowl to the window. After examining it carefully, he took a penknife from his pocket, scraped the top of the bowl, brought it back to the bench, quickly put the carburetor together, and reinstalled it on the car. Then he stepped on the starter. The engine ran smoothly.

It was one minute to four. "There's your car, Miss," Gus said. "Tell your father I had it ready on time."

"You can tell him yourself," Miss Hopkins said. "He'll be here soon. I was going to drive him home, but I'm overdue for tea at the Van Name's and can't wait."

As she got into the car, she turned to Stan. "You might drop in some evening. It would be quaint hearing about what happened at that old hick school after I left."

Stan grinned. "Well," he said, "I've got Friday evening open."

She let in the clutch. "Call me first—I might be busy."

**L**OOKING as grouchy as usual, Vern Hopkins charged in a little later. "Where's my car?" he demanded.

"Your daughter took it," Gus said.

"What?" Vern howled. "Now I'll have to walk some more."

"That's what she said," Gus replied.

Vern's face softened. "Well," he said, "you have to let the kids have their way. By the way—you didn't find out what's the matter, did you?"

"Yes, I found it—and fixed it," Gus grinned. "You caused the trouble yourself when you put on that new gasket."

"Nonsense!" Vern snapped. "There's nothing wrong with that gasket."

"That's right," Gus said. "But when you put on the new one you didn't take off the old one. You didn't notice the old one because it was bonded to the carburetor bowl by pressure and heat and because it had become so discolored that it looked just like the bowl. I didn't spot it until I happened to shine a light on it."

"Well," Vern objected, "how could an extra gasket cause all that trouble?"

"On your carburetor," Gus explained, "both the float and the needle valve are mounted on the upper body—lid to you. The extra gasket raised the float and valve seat, and so raised the gas level in the bowl—just enough to make the fuel mixture too rich. That, of course, caused choking and missing and overheating of the engine. Now, how about that supper?" **END**



## ***Mechanics and Handicraft***



**Build Your Own Multimeter** PAGE 204

**Winged Box Kite** PAGE 170

**Using Your Drill Press** PAGE 176

**Model Hilsch Tube That Works** PAGE 190

**Homemade Photo Speed Flash** PAGE 198



# Guest Tray and Mug Hammered on Wood Form

By Morton Bartlett and  
James Harris



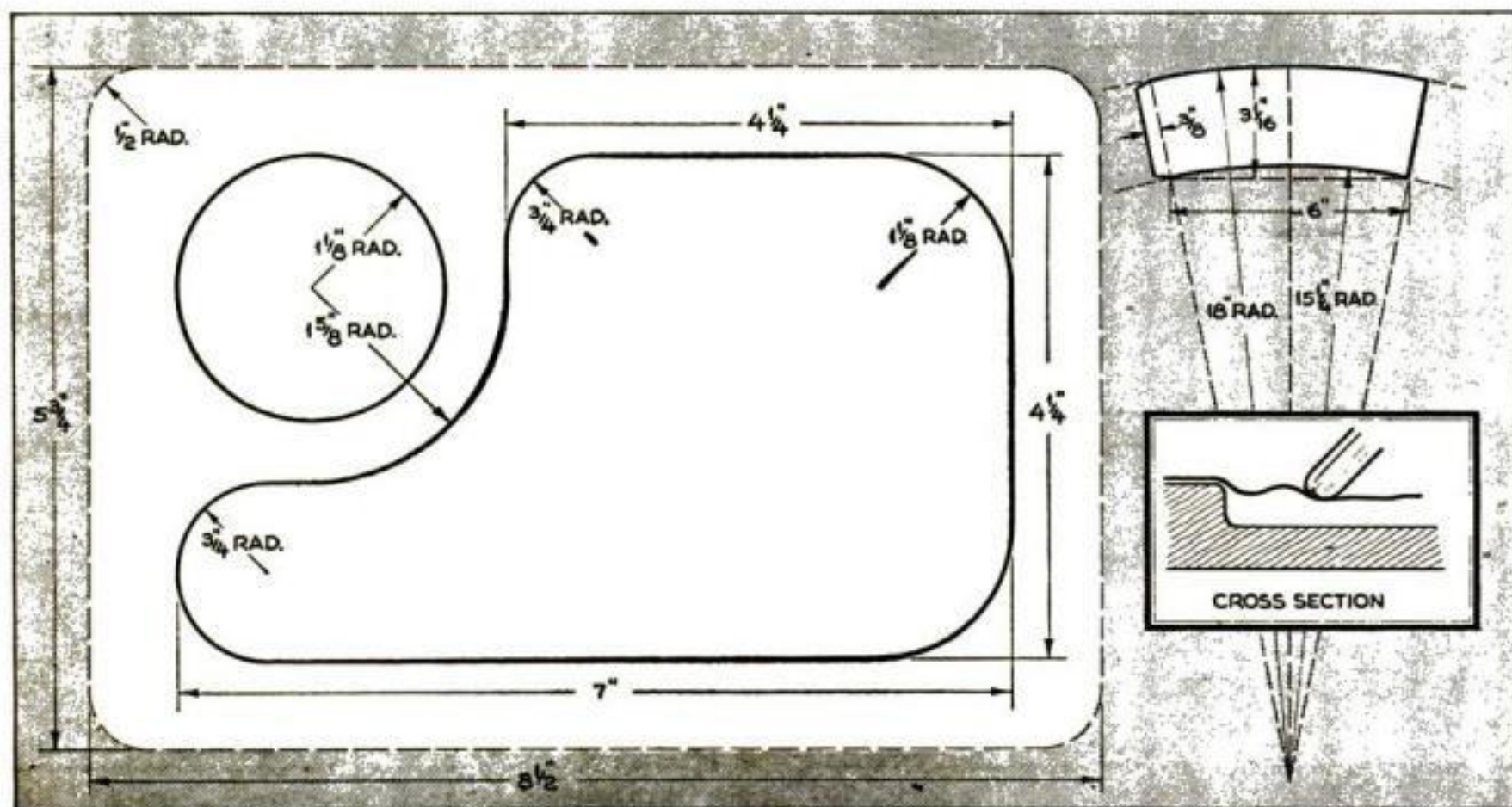
**F**ORMED from soft copper and given an antique finish, a set of these individual serving trays and matching mugs or cups makes a gift that should please any hostess.

Make the tray mold or form of a 2" by 10" by 12" block of hardwood, carving or routing the recesses to a uniform depth of about  $\frac{1}{2}$ ". Also cut four clamp blocks  $\frac{3}{4}$ " or 1" by  $1\frac{1}{2}$ " by 7" and drill so they may be screwed to the form at the edges of the recesses to keep the copper sheet firm. Whittle two pine wedges 1" by 1" by 4" for hammering the metal, giving one a straight rounded tip and the other a curved rounded tip.

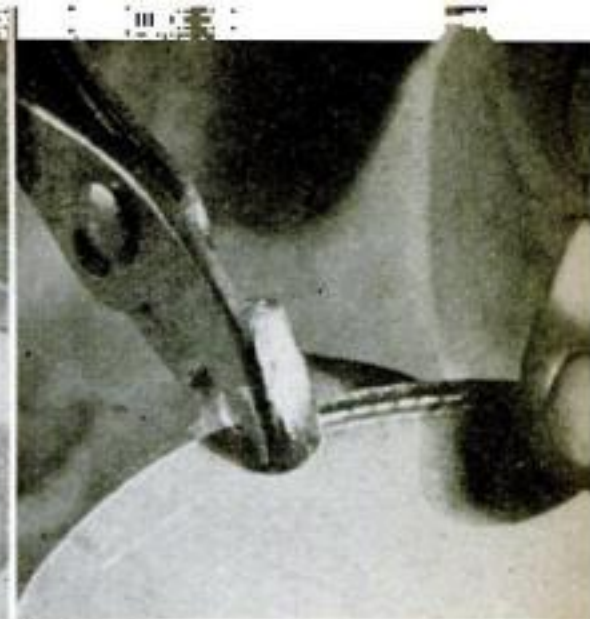
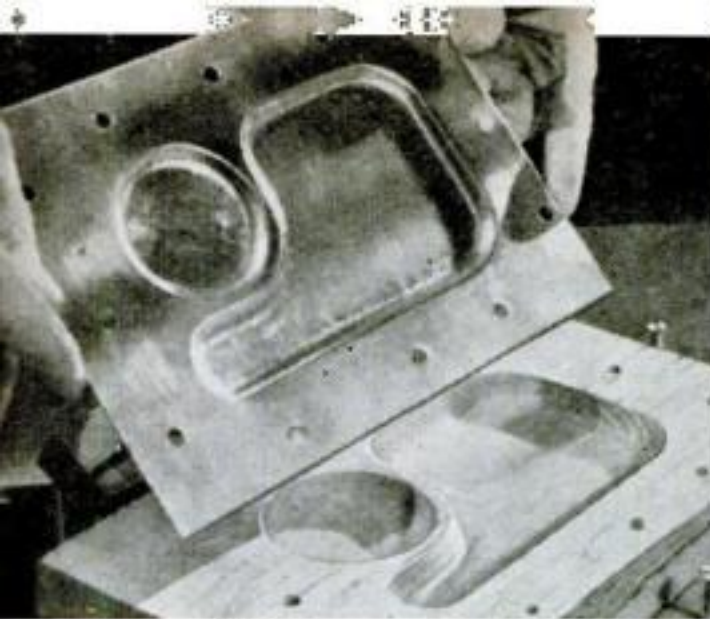
Cut a 7" by 10" rectangle from soft 16-oz. (24-gauge) copper and drill holes around

the edge to match those in the clamp blocks. In forming the copper, use the straight-tipped wedge for straight lines and convex curves and the other for corners and the mug seat. Begin hammering about 1" away from the ridge between the mug seat and the sandwich section and work toward it, as illustrated in the cross-section detail. In this way, a wave of copper will precede the tool and provide stock to expand into the recess without pulling material away from the cavity on the other side of the ridge. Work down all edges gradually and evenly, going around and around until a satisfactory depth is achieved. No annealing should be necessary.

Remove the hammered sheet from the







**Hammer the tray** on a wood form, clamping the copper sheet with four holding blocks before driving it into the recesses with pine wedges. Then lay out and scribe the outer edge, inside

the drilled holes, and shear away the waste. A decorative bead may be applied to the edge with an inexpensive pair of pliers that have been adapted for use as a chasing tool.

mold, scribe the outline indicated by the dotted line in the drawing, and shear off the waste. In this case, the bead was made with a rivet crimper used as a chasing tool. Alternatively you can use a pair of pliers ground so that there is a bead on one face and a notch on the other (PSM, Sept. '47, p. 168).

The pattern in the drawing may be used either for a cup or mug, depending on which end is closed. Roll the copper with the fingers, drill the edges, and then rivet and solder the seam, preferably with silver solder since soft solder is not ideal for receptacles that are to contain drinks. Should copper rivets be unavailable, you can substitute 7/16" No. 4 copper tacks by snipping off segments of the head, inserting in the hole, cutting to length, and peening.

If possible, solder the bottom and the seam at the same time. For the cup, the bottom has a flared, crimped edge produced with the same pliers or staking tool used on the tray, or with a gear crimper (PSM, Sept. '47, p. 170). If you use the pliers, hold them at a tangent. Squeeze and twist slightly to bend down the flare. If you prefer to make the mug instead of the cup, drop

a 2 7/32" disk into the larger end and solder in place.

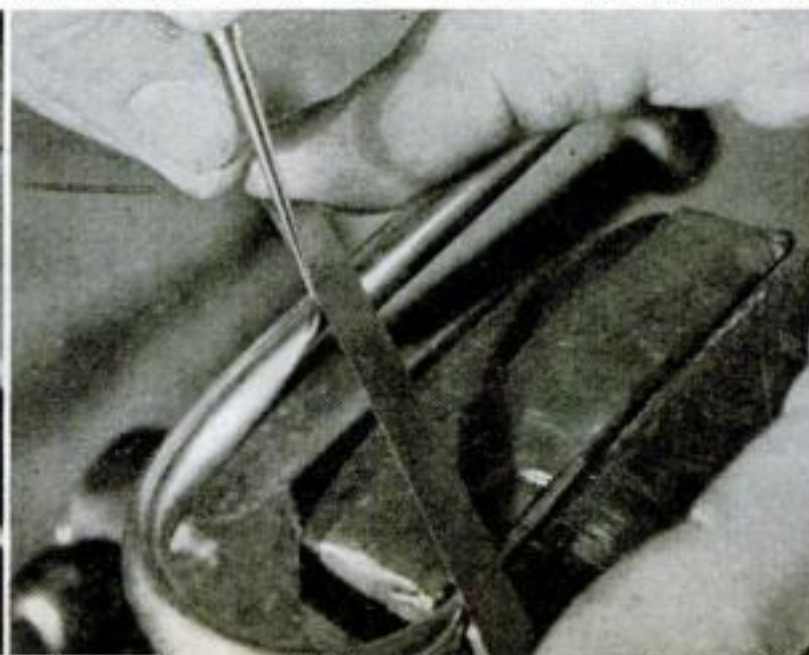
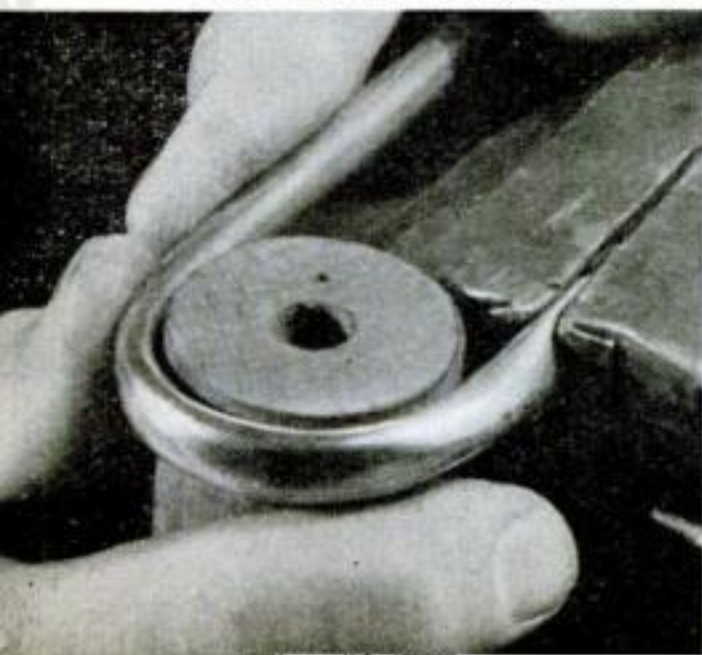
After forming the handle as seen below, cut 1/2" from the flattened end. Clamp to the mug and soft-solder the handle in place. The open lower end can be soldered over the bottom seam rivet to conceal it.

Initials may be scribed, cut with an electric vibrating tip, or etched with acid. For the latter, clean the metal well with strong soap, water, and steel wool. Then rinse and dry thoroughly. For a raised letter, simply paint it on with black asphaltum varnish. For a sunken letter, paint everything else with the varnish, leaving bare that part which is to be sunken. Immerse for 10 to 20 min. in a solution of 1 part nitric acid, 1 part sulphuric acid, and 1 part water. Wash well and remove the varnish with gasoline. It's best to try a scrap first.

An antique finish may be obtained by applying, with a saturated rag, a solution made by dissolving about 1 cu. in. of potassium sulphide in 1 pint of water and adding 6 drops of ammonia (PSM, Sept. '47, p. 171). Since the tray and mug are to be used for food, it is best to preserve the finish with lacquer rather than wax.

**Bend the mug handle** from 3/8" copper tubing. First, scribe it 1/2", 1", and 4" from one end. Flatten 1/2" in a vise, bend to 180 deg. on a wood form 1 7/16" in diameter, flatten to the

1" mark, scribe at the angle indicated by a rule laid across the 1" and 4" marks, bend the flattened end to this angle, and cut off the other. Then solder the handle to the mug.







A Jacobean table from England, left, provided the inspiration for a modern version, right.

## ***Old and New Tuckaway Tables Fold Flat***

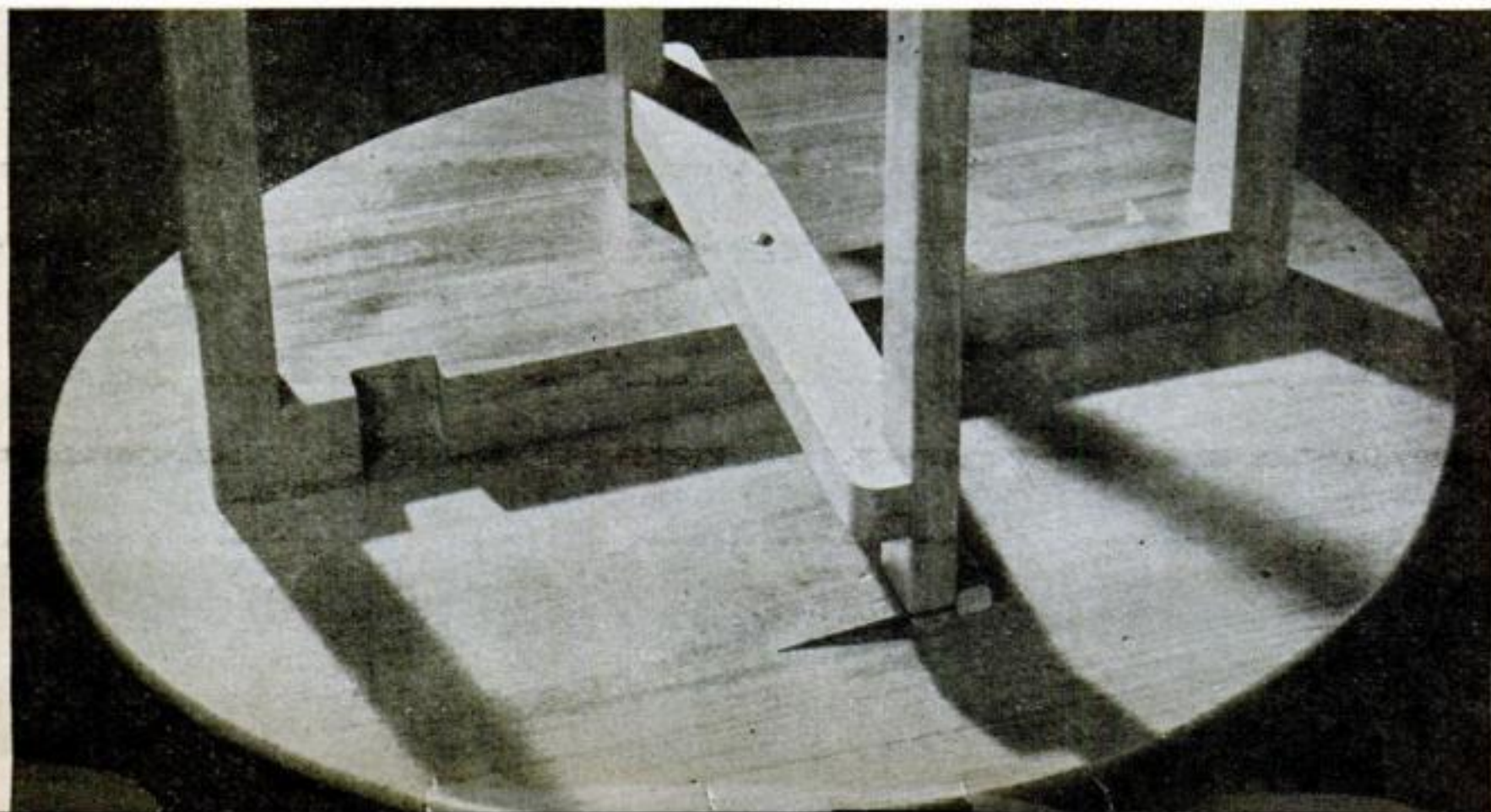
***By Joseph Aronson***

WHEN an antique English folding table of the type called a "tuckaway" recently came into my hands, the method of construction and operation seemed so simple and effective that I decided to make a modern version.

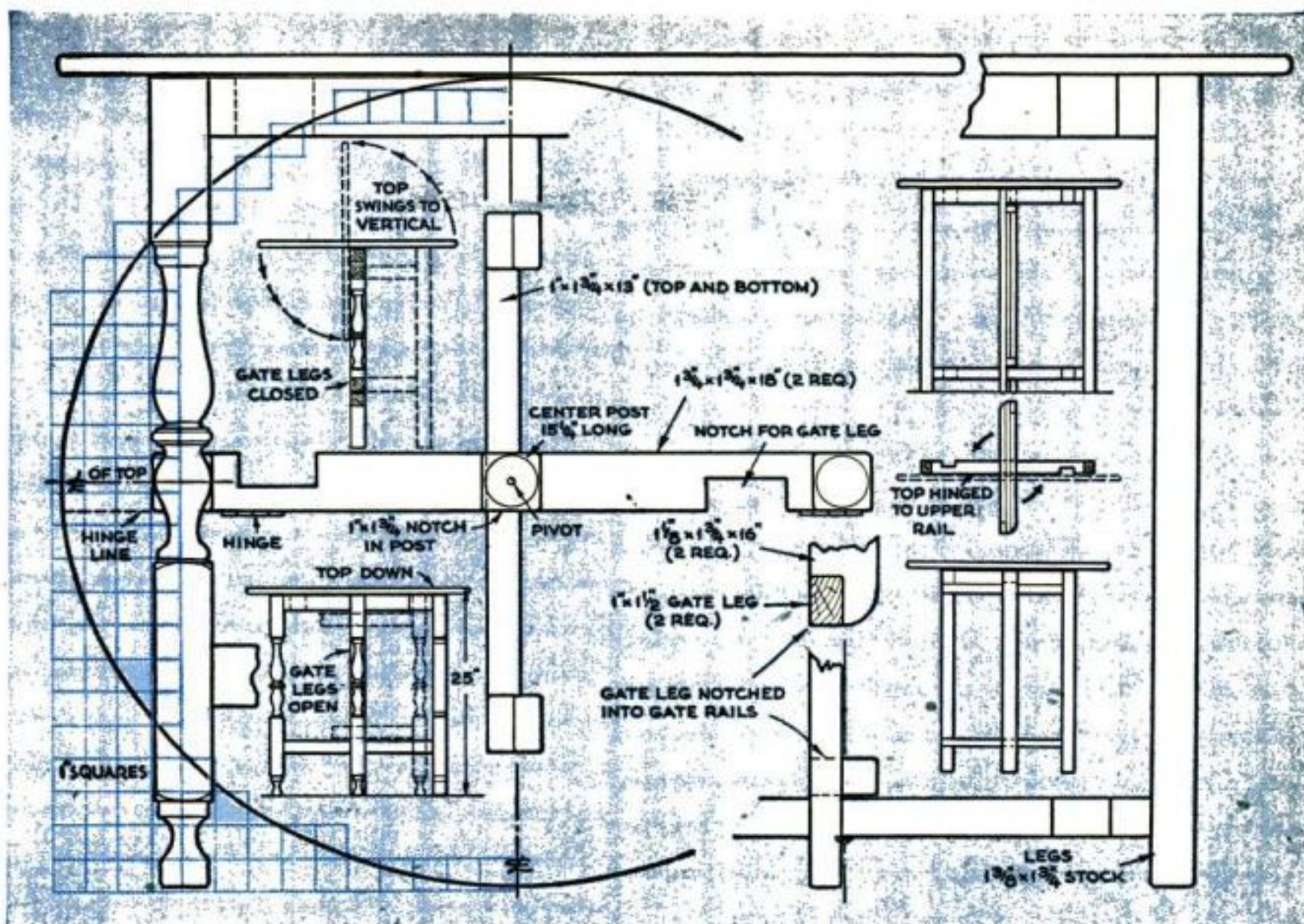
The original is styled in the Jacobean tradition. Such pieces may date anywhere from 1600 to 1800. Of heavy dark oak, the legs are identical turnings made into two

A notched wood wedge underneath the top locks one leg in place when the table is open.

This may be made in three parts, positioned, and then attached with glue and flathead screws.







Either turned or rectangular legs may be used. With the latter, the center post is omitted.

gates by rectangular stretchers, notched into one another to fold compactly. A similar turning with the foot omitted is located at the center, a free-fitting dowel serving as a pivot. Since the top is hinged to one gate, the entire table will fold flat for storage. A notched wedge under the top holds the gate in position when the table is open.

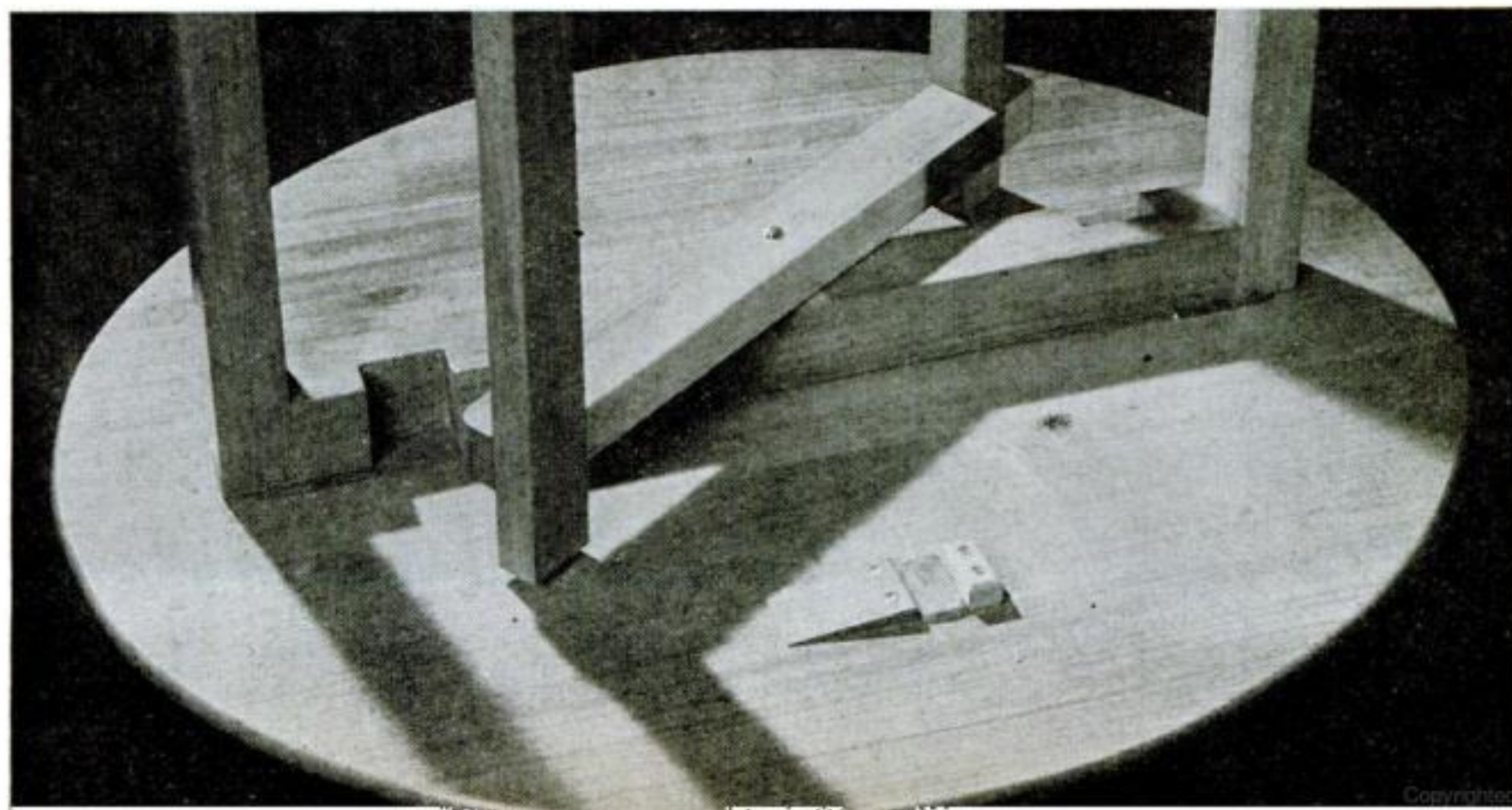
To suit the new version to modern decoration, it was made of mahogany, and legs

of rectangular section were used. However, legs could be turned just as well. The moving parts are pivoted on screws and washers, the center leg of the original design being omitted.

Gains were cut for the two small butt hinges so that the top rail would rest flush against the table top. The locking wedge, built up of three pieces, was located at 90 deg. to the other legs.

**Pivoted** by means of screws and washers, the legs swing into notches cut in the rails. Two

hinges allow the top to be folded flat against the legs when the table is to be stored away.





# Earring Tree Turned from Dural

**S**TANDING on a dressing table, this earring holder looks like a tiny bejeweled Christmas tree, and her ladyship is sure to forgive you for locking yourself in the workshop for the few nights that it will require to complete. To see it in full color, turn to page 136.

Starting with a length of  $\frac{3}{8}$ " dural bar, turn the column to the dimensions of the full-size drawing below. Grind the cutting tool with a decided back rake; use a fine feed and a high spindle speed. Polish to a high luster with fine abrasive paper and plenty of oil. While the work is still in the lathe, thread the shank  $\frac{1}{4}$ "-28.

After protecting the polished surface with tape and clamping the column in a milling vise, mill three slots  $\frac{3}{8}$ " by  $\frac{1}{2}$ " at the points shown. If you have no milling attachment, perhaps you can clamp the column at center height on the tool slide. In a pinch, the slots could even be made by drilling a series of holes and filing away the waste between them, but this is slow work. Remove any burrs from the slots with light touches of a file.

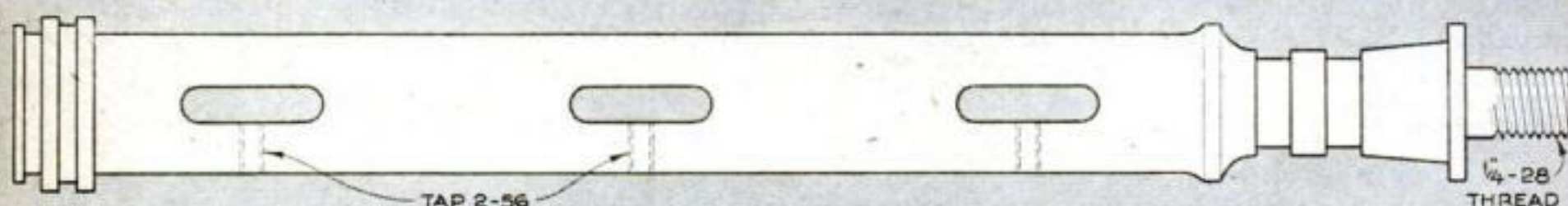
When the slots are milled, turn the work 90 deg. and drill three No. 50 holes, centering each in relation to the slots and tapping 2-56 for setscrews.

Out of  $1\frac{1}{4}$ " hexagon dural bar, turn the base as in the full-scale drawing at the right of this page. After polishing the turned por-



tions, reverse the work in the chuck and turn out a  $\frac{1}{32}$ " recess to take a felt disk. By using the index pin or back gears, lock the work in the required positions to dress the hexagonal faces with a file. Thread the base  $\frac{1}{4}$ "-28 to fit the column.

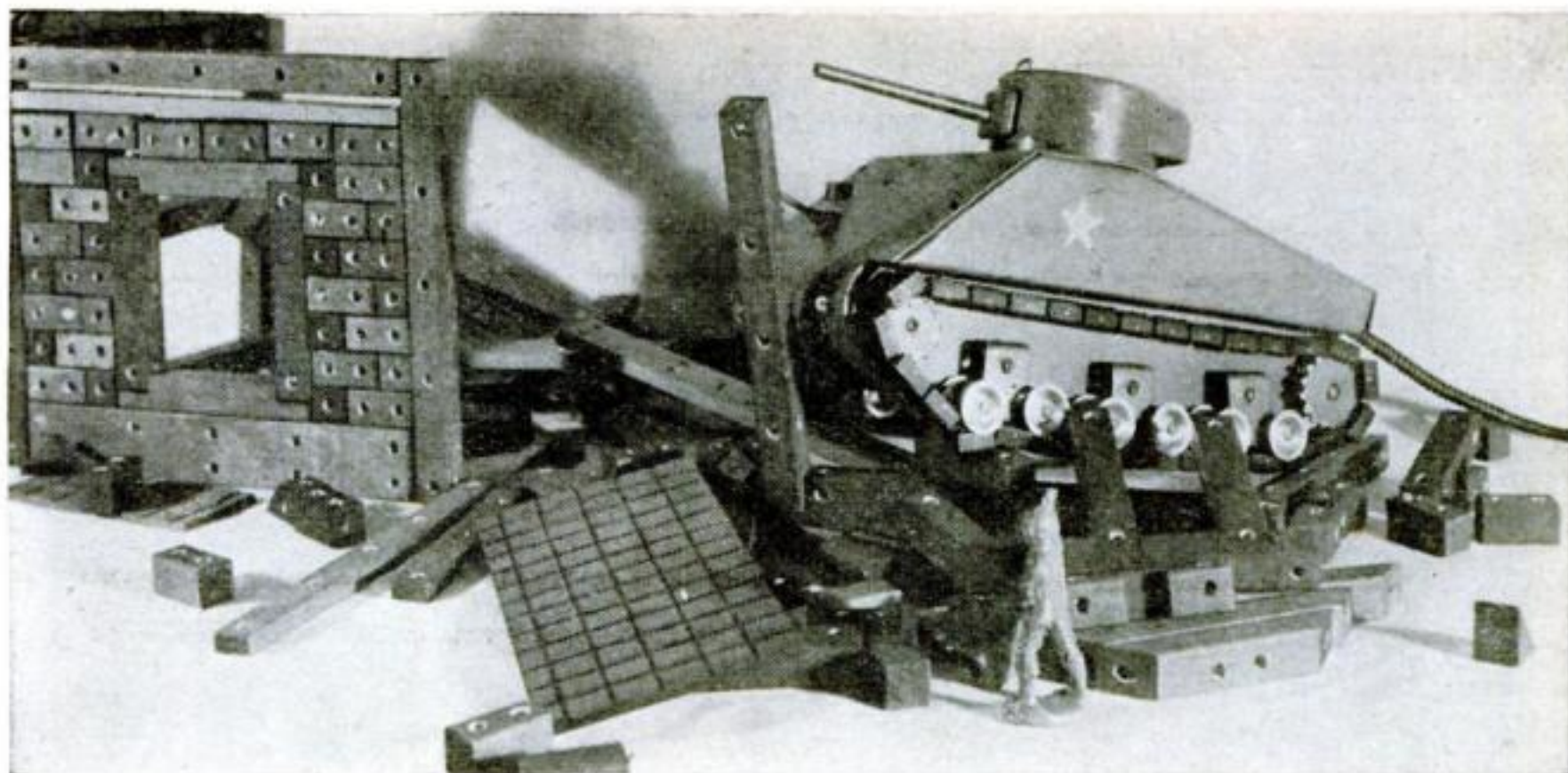
From  $\frac{1}{8}$ " clear plastic, cut three strips  $\frac{1}{2}$ " wide, one 4" long, one 5", and another 6". Round the edges of each strip with a file, testing frequently to make a press fit in the slots. Wet-sand with fine abrasive, buff, and give a final polish on a soft cloth buffing wheel—without compound. Assemble by centering the plastic bars in the slots and tightening the setscrews. Complete the job by cementing a felt disk on the bottom.—BILL LUTHER.



Various steps in making the holder are seen here. At the left, polishing the column after

it has been turned; center, milling the slots; right, dressing the hexagonal base with file.





Electrically powered, the tank makes short work of toy forts in living-room war maneuvers.

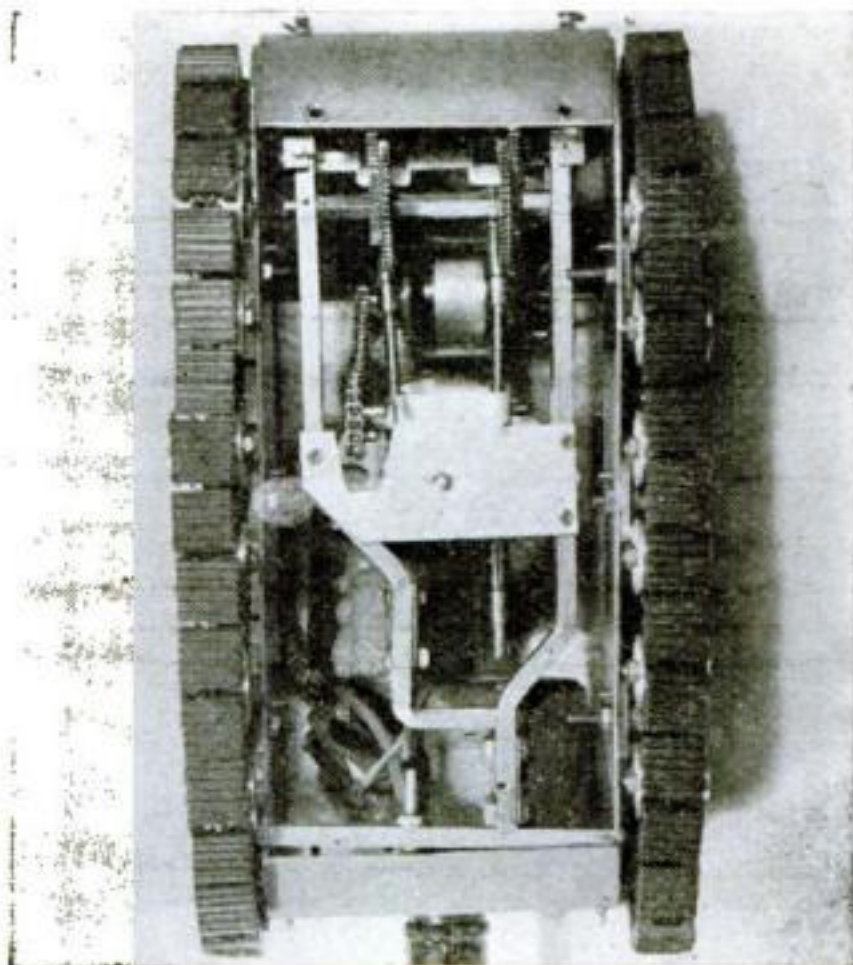
## ***Model Tank Packs a Wallop***

**E**QUIPPED with four electric motors, this control-line tank brings a remarkable note of realism to living-room war games in the home of Alfred J. Brosseau, of Cam-

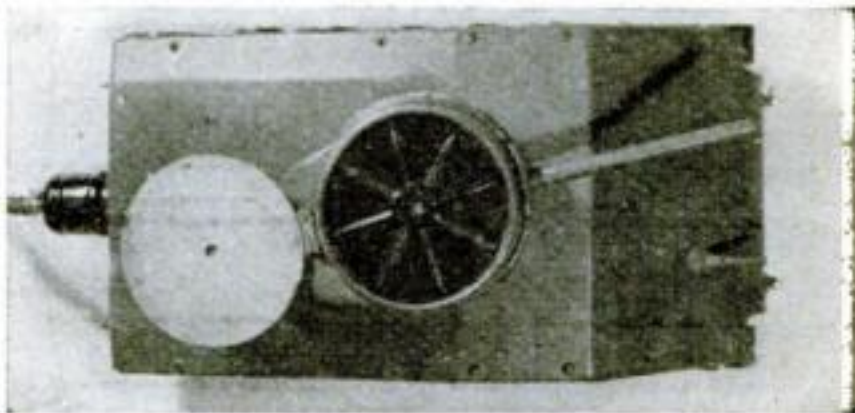
bridge, Mass., who spent a year and a half building it. Measuring 6" by 12", the model can imitate any action of its big brothers.

Two motors drive the tank, one being geared to each track. Another operates the turret, turning it through 360 degrees right or left. The fourth fires plastic shells from the turret by means of a train of gears, levers, springs, and a hammer.

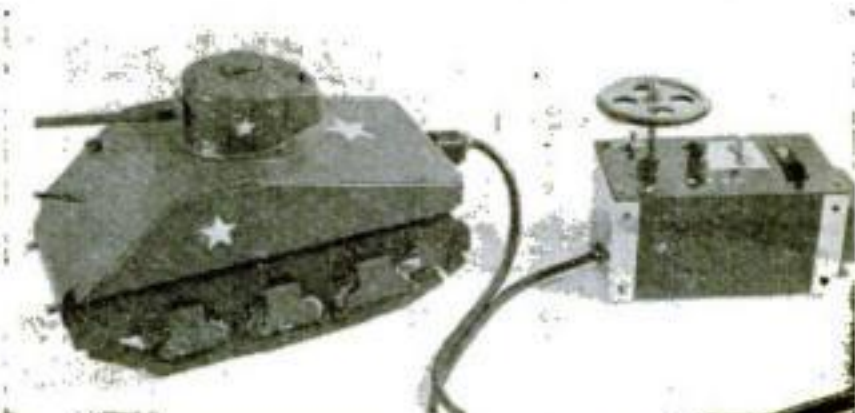
All operations are controlled by switches on the transformer box through a connecting cable to the tank, which can be made to slow down, speed up, turn, or fire at will.



Each track is driven by its own motor. These were taken from automobile defroster fans.

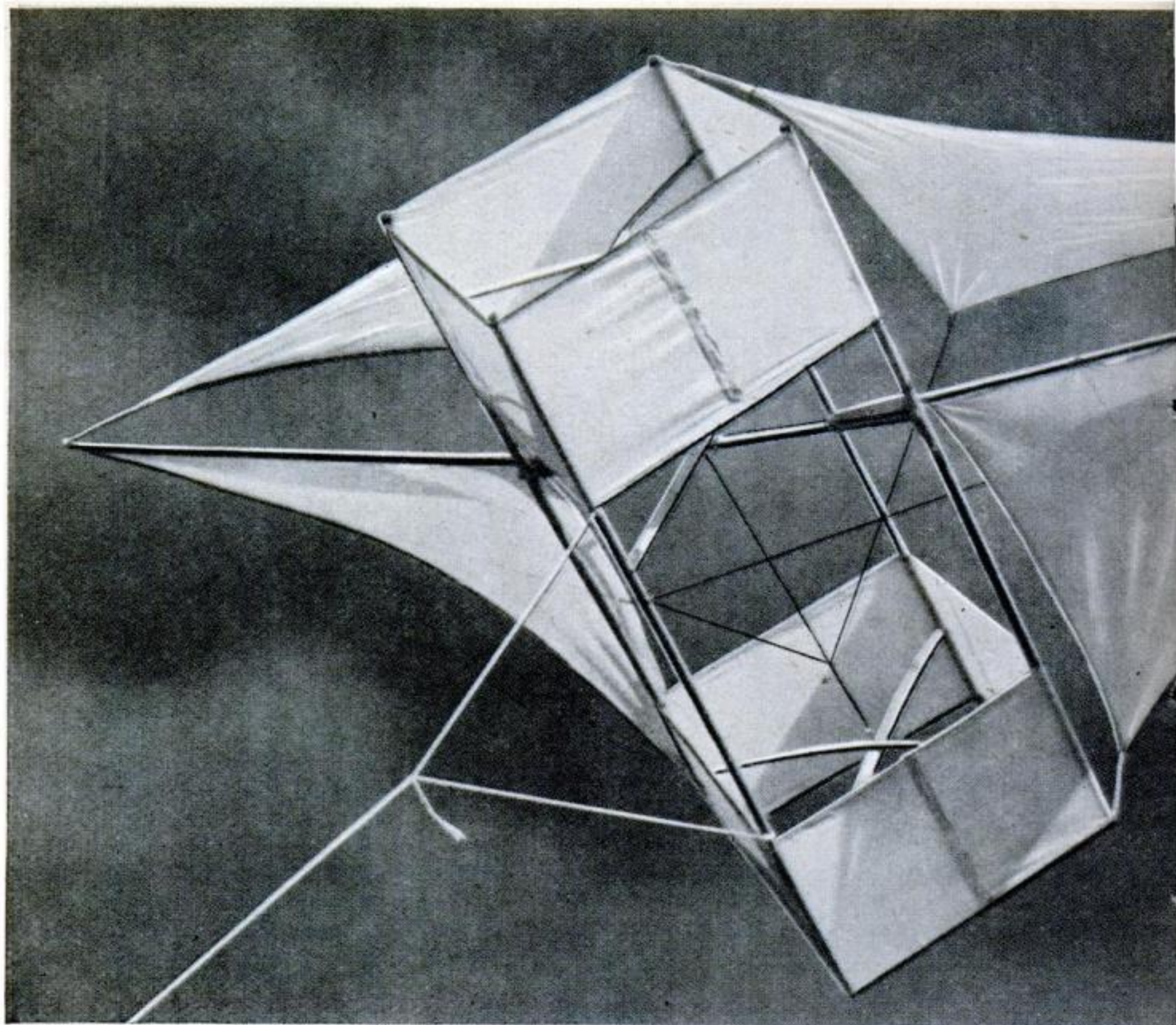


Plastic shells loaded in the top of the turret are shot mechanically with considerable force.



All controls are located in this box. The tank can be maneuvered anywhere within a 35' circle.





# Marconi-Rigged Kite Soars

**With hollow spars and stunsails for light airs, the Flying Cloud will outperform conventional box kites.**

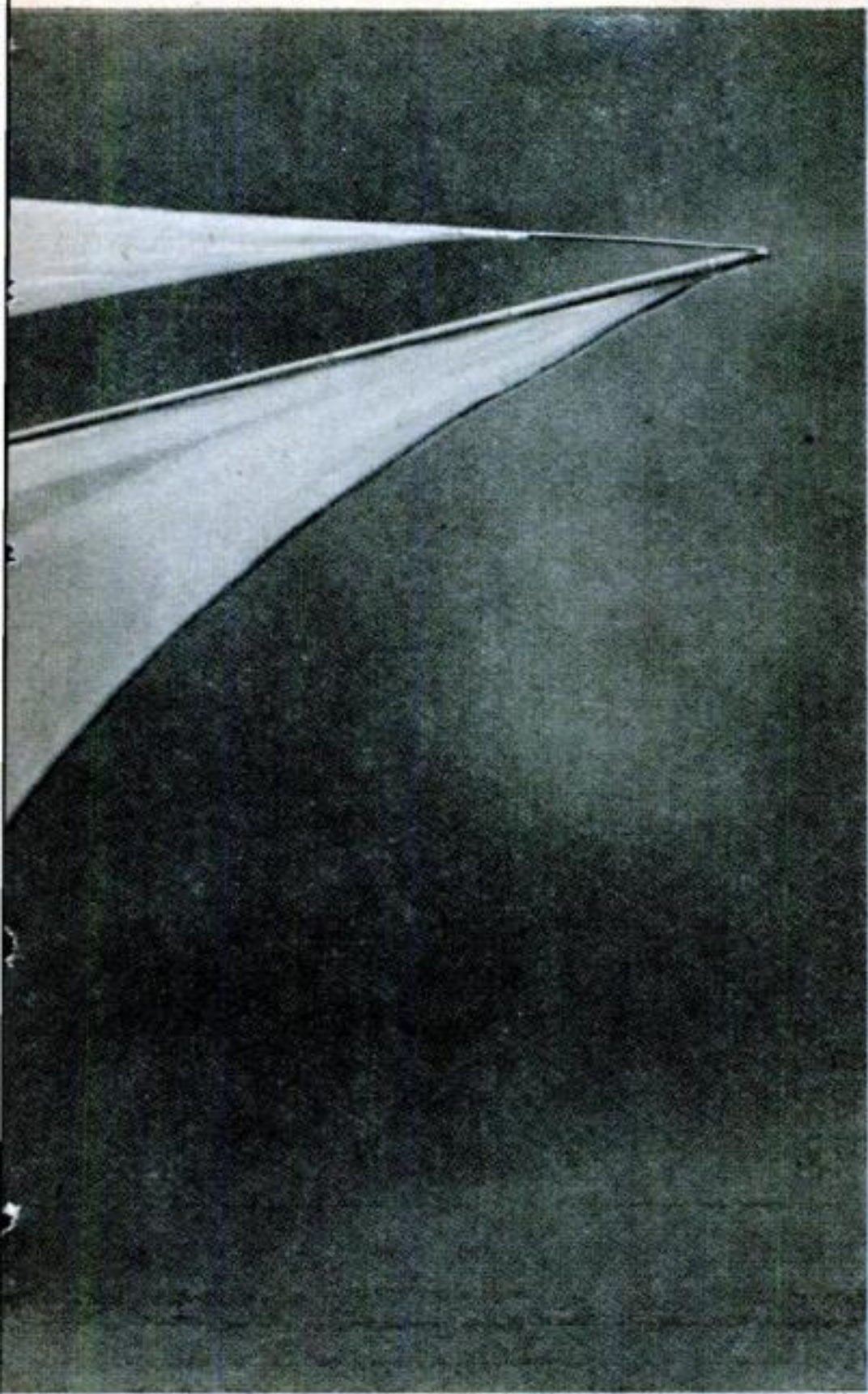
**By W. Mack Angus**

**H**ERE'S a kite that will win all honors in a breeze—or in practically still air, for that matter. It is called the Flying Cloud and, like that famous clipper ship, it performs superbly when the wind is up. In a good blow it uses just its working sails, but it can also set auxiliary studding sails, or

“stunsails,” to sustain it in light air. With all sails set, the wingspread of the Flying Cloud is over 8', yet the whole affair packs into a 42" mailing tube for stowage and transportation.

As indicated in the drawings and photographs, Flying Cloud's basic element is a square box kite whose cells form the working sails. Hollowed spars make the unit exceptionally light, yet it's airworthy and sturdy enough to withstand good sailing winds. The studding sails, which may be compared to the jibs and mainsails of racing sloops, possess the high aerodynamic effi-

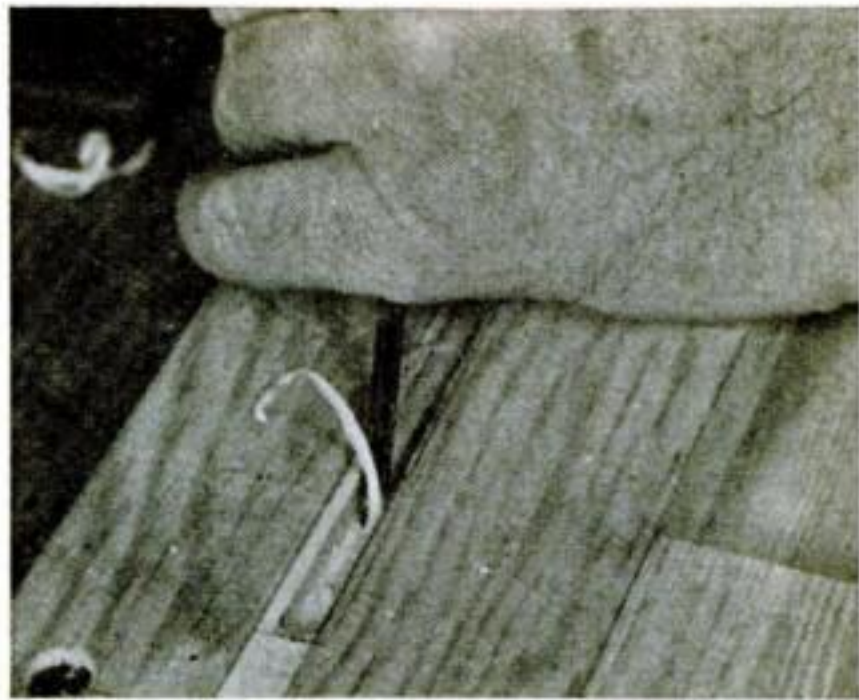




## in a Breeze

ency of the Marconi rig. They will carry Flying Cloud aloft in a breeze so light that even flimsy paper-covered kites will barely hold the air.

Each of the four spars of the box kite and the two stunsail spars is made of a pair of hollowed  $\frac{1}{4}$ " by  $\frac{1}{2}$ " spruce sticks glued together. After the glue has set, the spars are planed into octagonal—and finally circular—shape, except for the flat spots where the spreaders, stunsail spar carrier, and spar-carrier's mate seat against them. These points are indicated by the varying sections shown in the spar details. After planing,



**Each spar is made** by hollowing two  $\frac{1}{4}$ " by  $\frac{1}{2}$ " sticks. A wooden jig makes hollowing easier.



**Glue the two parts together**, using waterproof glue and a wedge clamp made as shown above.

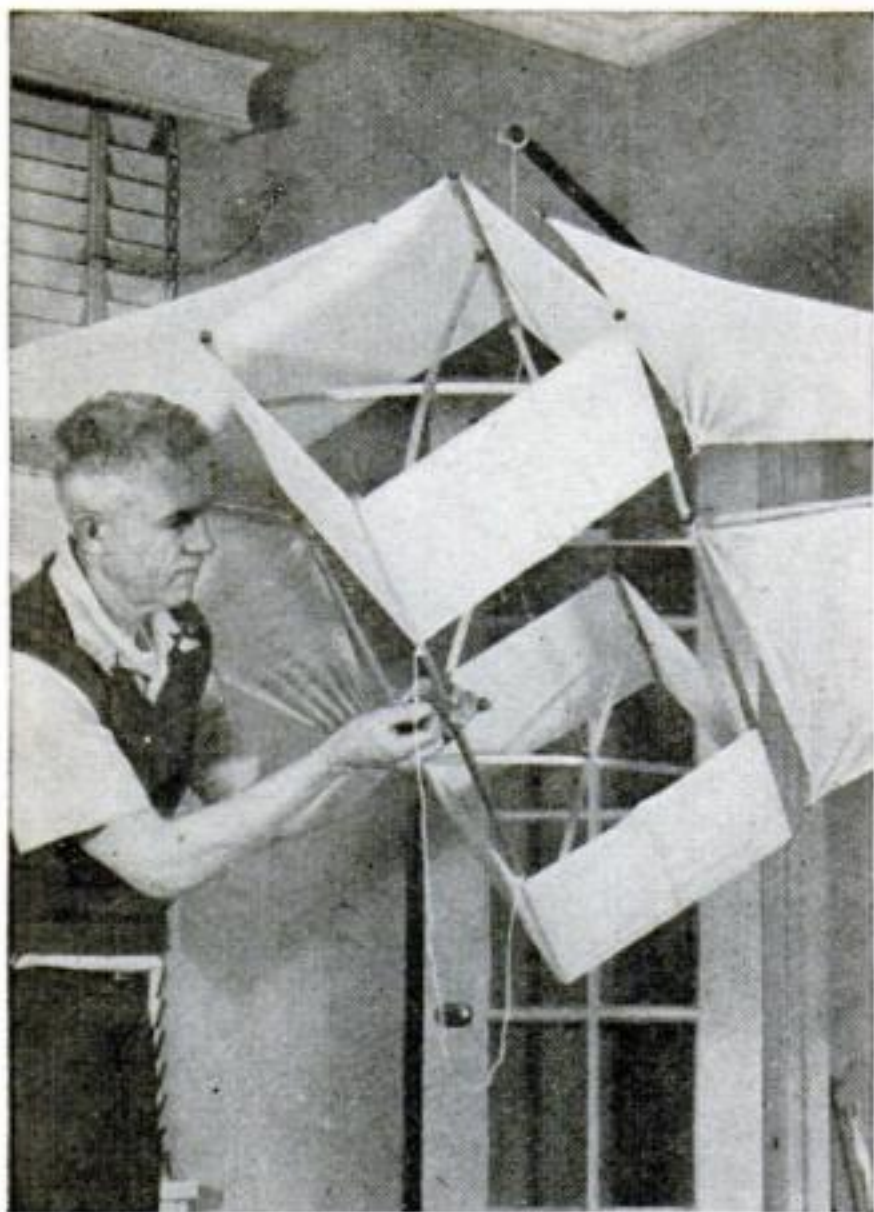


**Round the spar corners** with a plane, leaving flats where indicated so as to seat the crosspieces.



**Scrape the spars** as smooth as possible. They are finally sanded and coated with spar varnish.





**Assemble the kite and wings.** For easiest disassembly, use wire hooks to attach all cords.



**Stowing the kite.** The entire affair, sails and all, fits into a 42" mailing tube for storage.

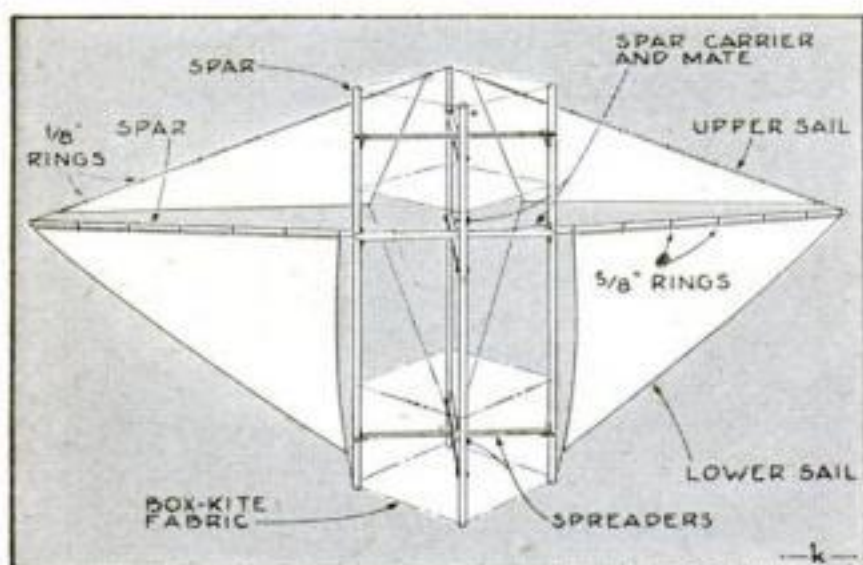
spars should be scraped and sanded. Wedge-shaped stops are glued to the spars to hold the socketed spreaders, carrier, and mate. These parts are made of spruce and plywood. Allow about  $\frac{1}{4}$ " extra length on the spreaders, then trim the jaws just enough so that the spreaders will be slightly bowed when snapped into place.

Sand all wood and coat it with spar varnish to prevent the absorption of moisture should the kite enter a cloud. Either a strong light paper or a closely woven light cambric may be used for the covering and sails. Cloth, of course, is necessary if the kite is to be flown in damp weather or into low clouds. If cloth is used, the warp, or

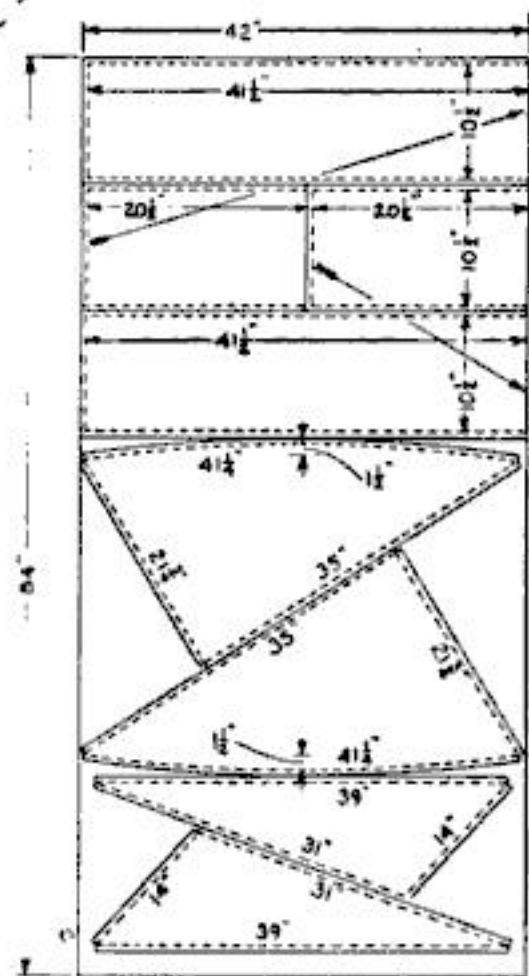
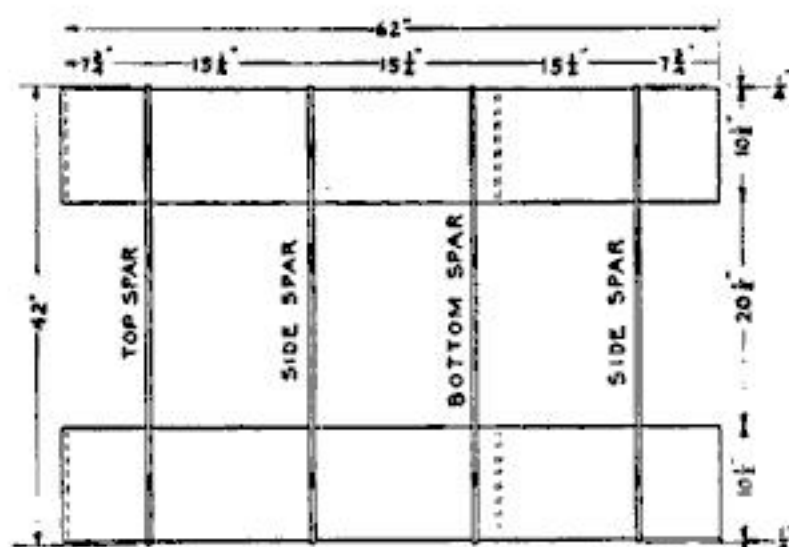
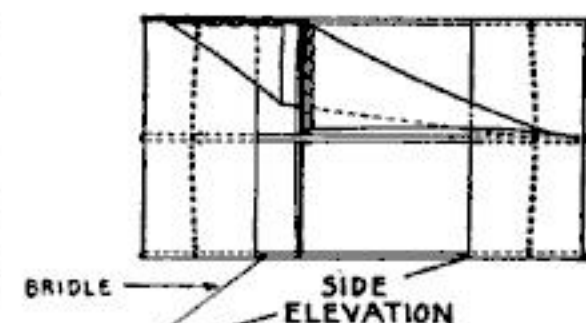
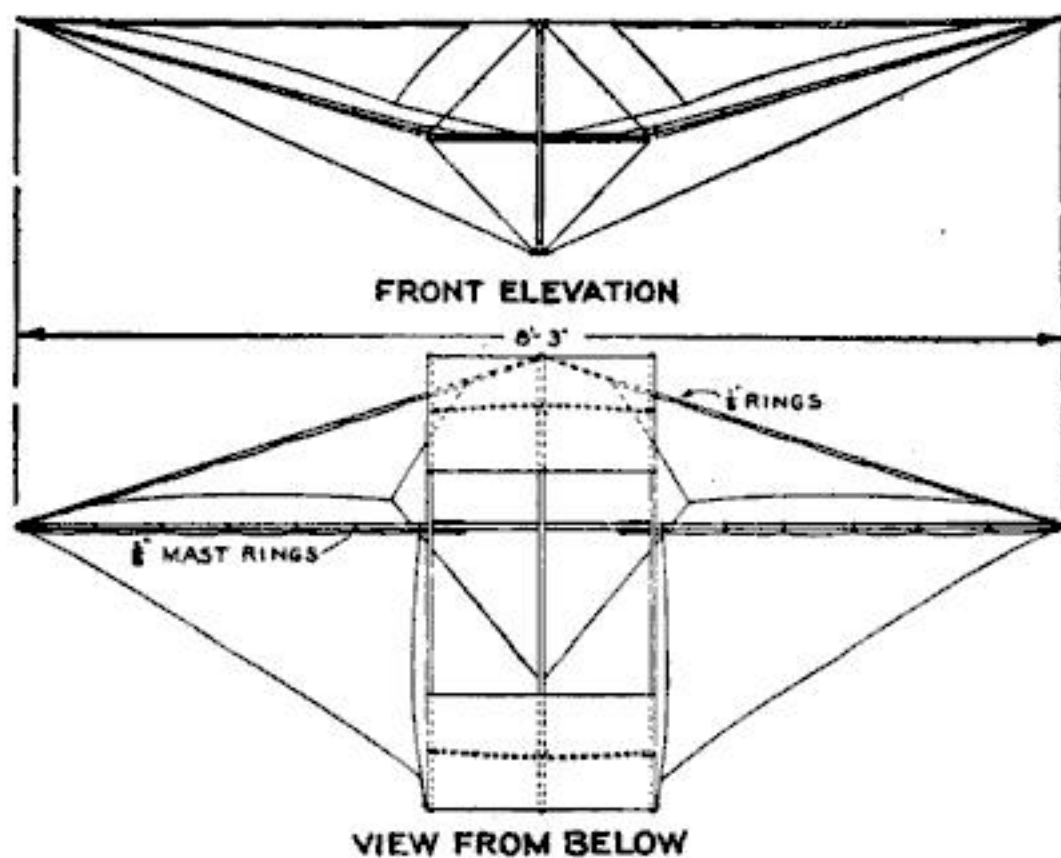
lengthwise threads, of the fabric should be at right angles to the long edges of the sails. The cutting plan given for 42" fabric shows how this requirement may be met. For other widths of material a different pattern is needed, but the same relationship of thread direction should be observed. Note that each of the working sails is cut in two sections; the arrows that cross from one piece into another indicate where the ends of the cloth must be stitched in order to obtain the necessary length.

For the stays and rigging of the kite, use a good quality of fishline or the type of linen line sold by hobby shops for rigging model yachts. All lines are secured to the frame by means of small hooks made from wire hairpins. These hooks connect with cord loops; do not use wire loops as the hooks may disengage them if the kite towers and slackens or shakes momentarily.

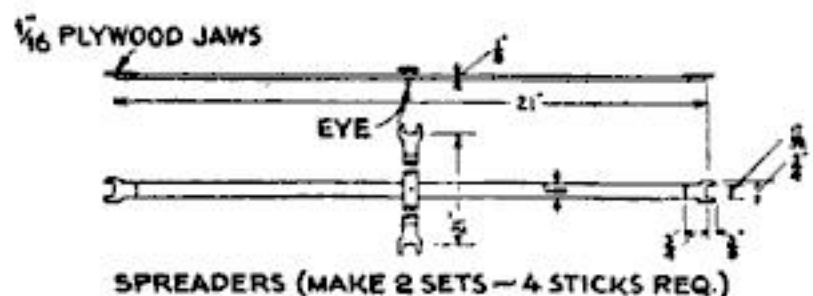
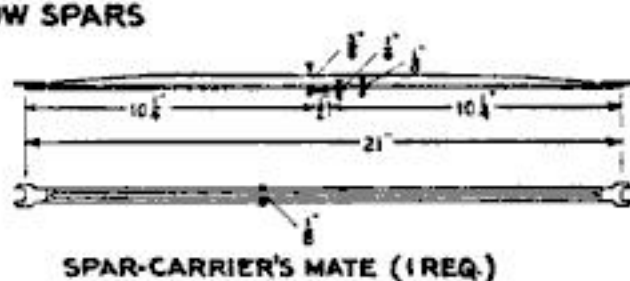
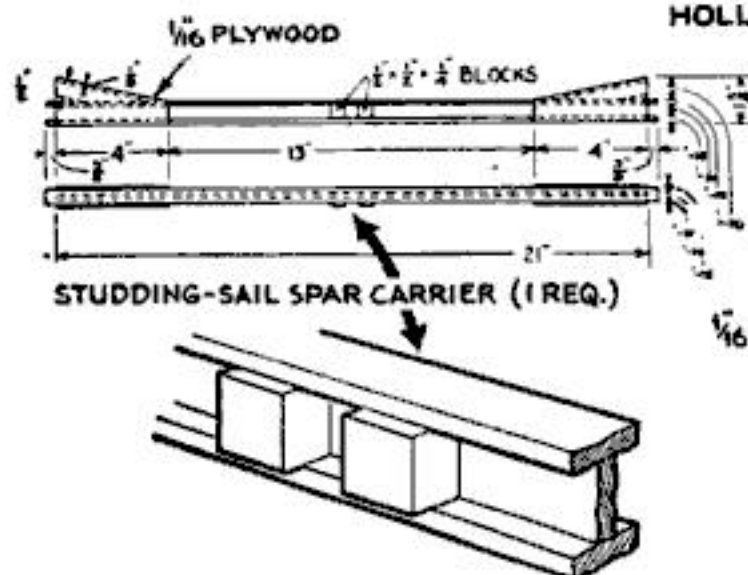
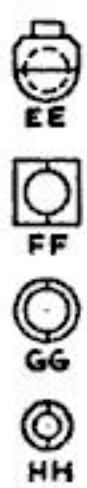
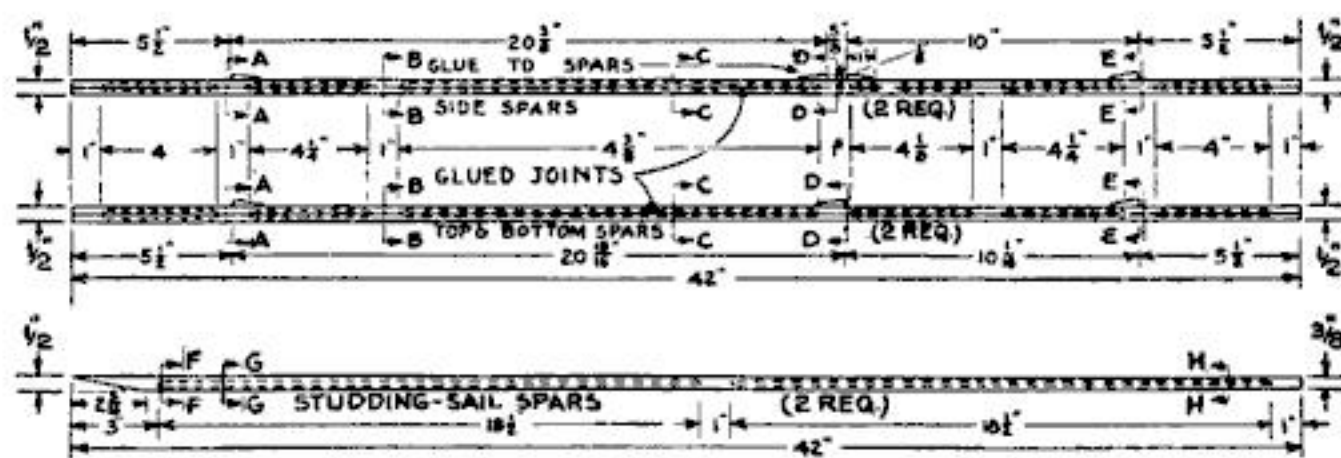
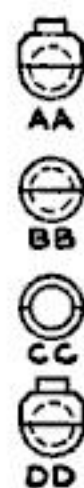
Fly the kite with the lightest twine of 30-lb. breaking strength that you can get. The arrangement of the bridle shown in the drawing is for light breezes; in strong winds shift the point of attachment of the line further back on the bridle. Do not use the stunsails in a breeze that is heavy enough to carry the box kite alone. **END**







DIMENSIONS ARE TO FINISHED LINES,  
SHOWN THUS - - - - -  
CUTTING LINES SHOWN THUS ———  
1/2" ALLOWANCE FOR HEMS AND SEAMS  
CUTTING PLAN FOR 42" MATERIAL





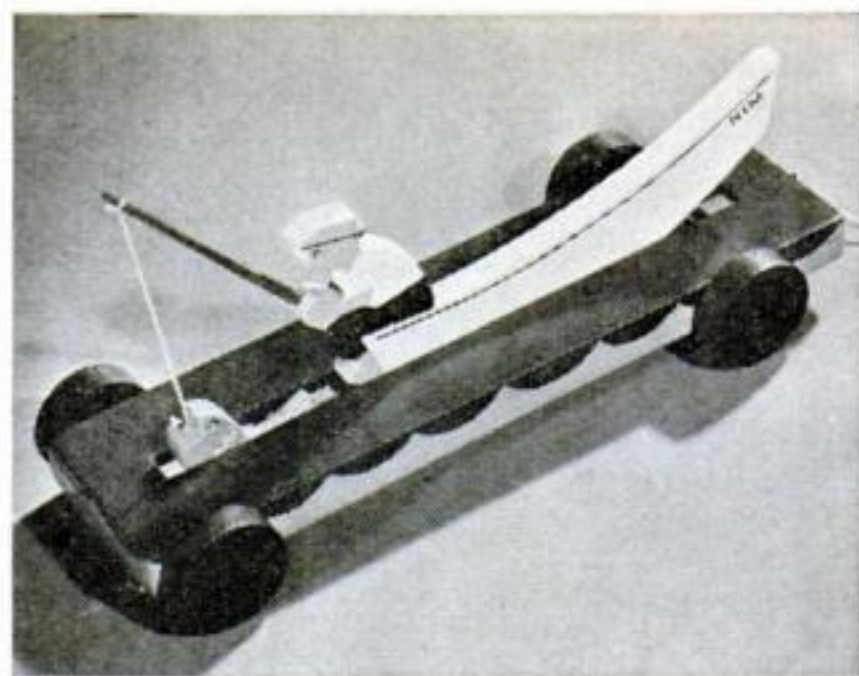
# Fisherman and Boat Ride Waves on Pull Toy

LOTS of action in a pull toy makes a hit with the kids. Here's one that more than fills the bill, for the little white boat rocks and the fisherman pulls the fish out of the water as the toy is pulled along.

Cut the top of the base from  $\frac{1}{4}$ " plywood, drilling a hole and starting the slot with a coping saw and finishing with a keyhole saw. The sides, front, back, and two hinge-pin supports are made of  $\frac{1}{2}$ " pine. Match the sides carefully, clamp them together, and drill holes through both simultaneously to provide a free fit for the  $\frac{1}{4}$ " dowel axles. Drill holes in the two supports in the same manner for the boat and fish hinge pins, the latter also cut from  $\frac{1}{4}$ " dowel.

The wheels may either be turned on a lathe or cut from round stock. Drill the axle holes so that the axles are a press fit. The cam that rocks the boat is a  $\frac{3}{8}$ " wheel with the hole drilled  $\frac{3}{16}$ " off center.

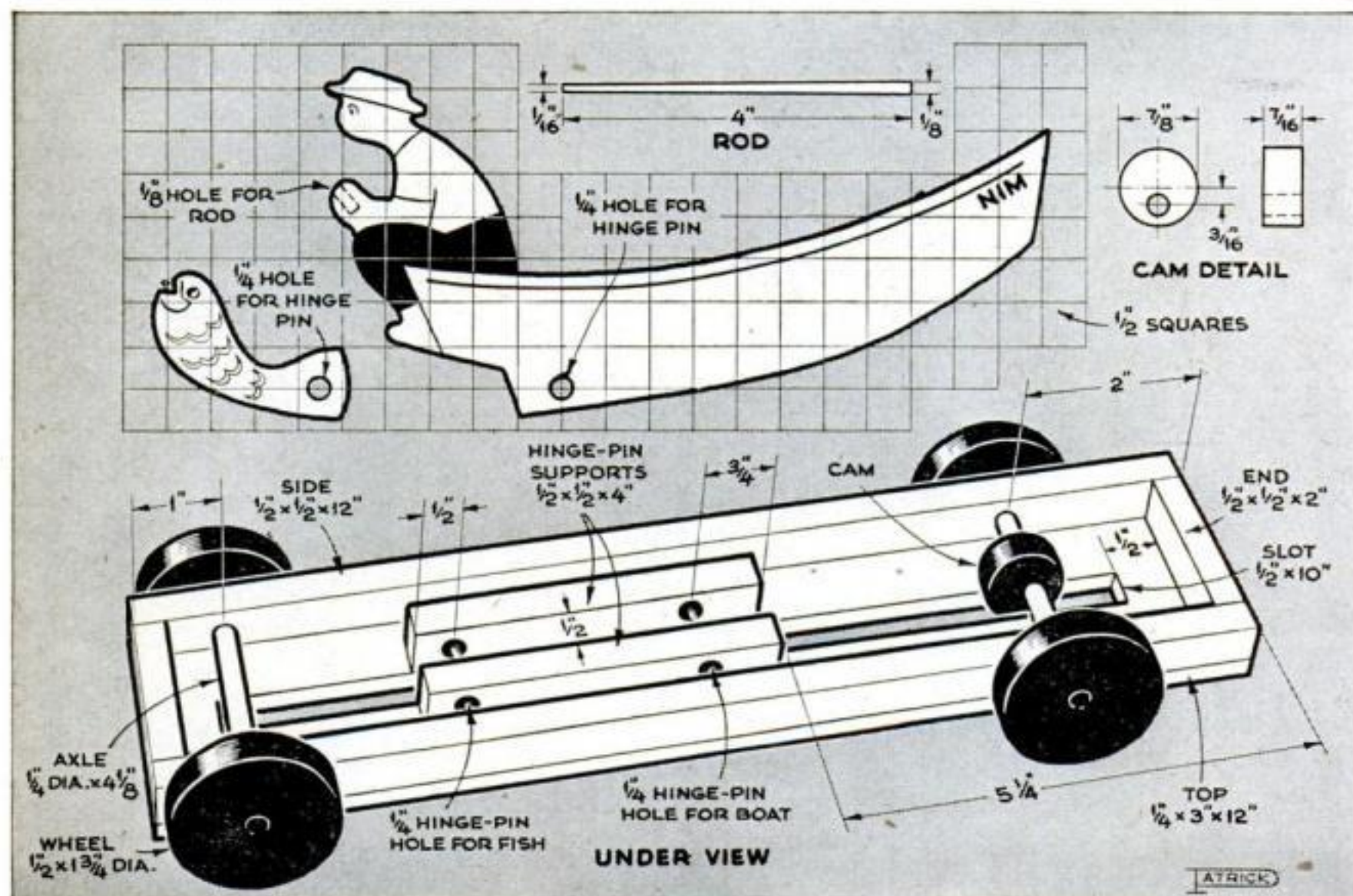
Saw the fish and the boat and figure from  $\frac{1}{2}$ " pine, drilling the  $\frac{1}{4}$ " hinge-pin holes first to prevent splitting. Also drill a  $\frac{1}{8}$ " hole in the hand of the figure to receive the



pole, a 4" dowel tapered from  $\frac{3}{8}$ " at one end to  $\frac{1}{16}$ " at the other. A thin length of bamboo or other flexible material might be used instead for even more realistic action.

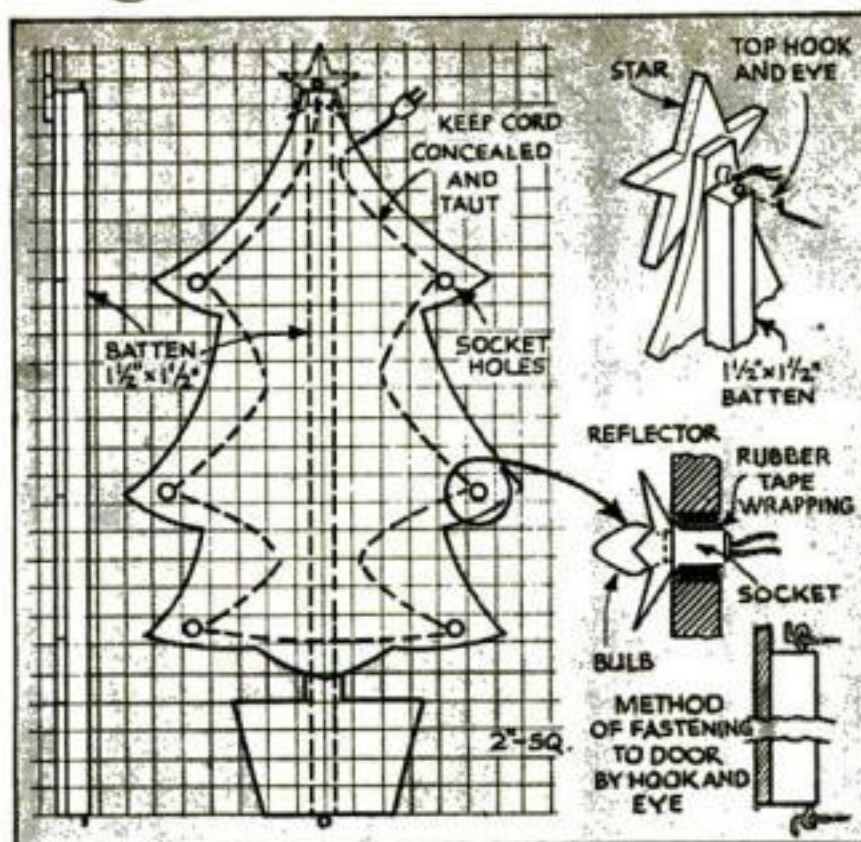
Shellac all the parts and then apply two coats of enamel. As seen in the color photo on page 136, the wheels are black, the base is two shades of blue-green, the fish red with yellow scales, and the boat white. The man wears a white shirt, black pants, and a yellow hat. Varnish or stain the fishing pole. Outline shirt, hat, and eye in black.

In assembling the parts, make certain the hinge pins and axles turn freely. Run a line from the pole to the mouth of the fish so it will move with the boat. Turn a screw eye in for the pull string.—JAMES J. O'HARA.





## Lighted Tree Decorates Door for Yule Season



ILLUMINATED by a set of standard outdoor Christmas lights, this painted ornament will provide a cheerful decoration for your door during the holiday season. Its size may be varied to suit the door.

Lay out and saw the tree and pot from outdoor plywood, composition board, or similar material. Cut the big star separately from a scrap of the same material and nail or glue it in place. Reinforce the tree cutout with an upright wood batten on the back.

Drill holes equal to the outer diameter of the socket lips and set the sockets flush with the outer face of the panel, wrapping friction tape around the body of each for a press fit. Wiring is concealed as indicated



by the dotted lines in the drawing. The feeder line must not interfere with operation of the door. In this case, it was connected to the porch-light socket, the cord being looped to provide slack for the door to open and close.

Reflectors in star form may be cut from tin-can stock. Paint the tree as desired, and glue on decorative strips cut from wallpaper borders.—MICHELE DE SANTIS.

## Polished Brass Key Serves as Lapel Ornament



OLD brass keys may be turned into attractive lapel ornaments or brooches. Such keys often are available for a few cents in secondhand stores.

First, clean up and polish the brass. One way of doing this is to use a cloth buffing wheel charged with rouge. Then, to the



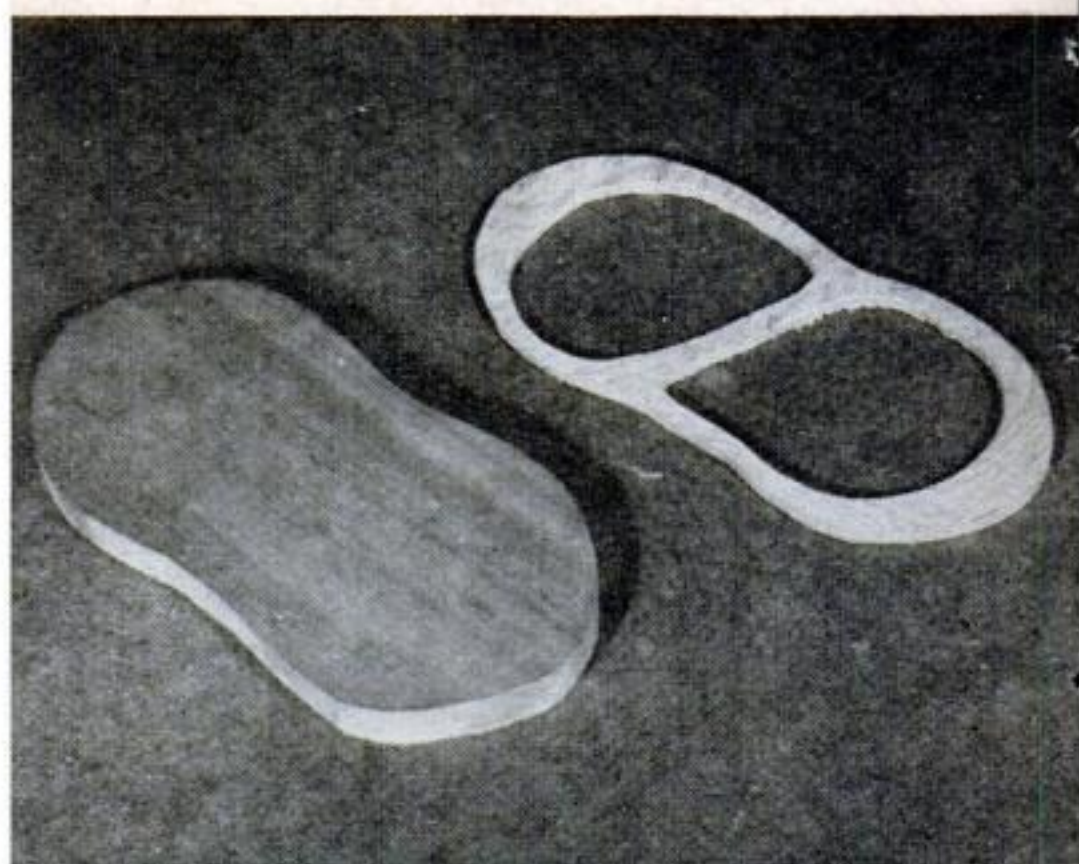
less attractive side (if there is a choice), solder a standard brooch pin, preferably one equipped with a safety catch. You can use soft solder, silver solder, or a brazing alloy that matches the metal. Finally, apply a coat of clear lacquer to the key to retard tarnishing.—WALTER E. BURTON.



# Let Your Drill Press Do It

**By Elma Waltner**

**I**F YOU use a drill press only for making holes in wood or metal, you are not getting full value from the machine. A drill press is, in fact, a versatile tool well suited to a wide variety of operations that will speed up and make much easier numerous jobs around a shop. Some of the extra tasks to which you may apply your press are illustrated in the photos on these pages.



**Routing irregular shapes** may be done with a pattern jigsawed from a scrap of thin stock. The inside of the pattern (at right above) and a wooden peg guide the router bit . . .

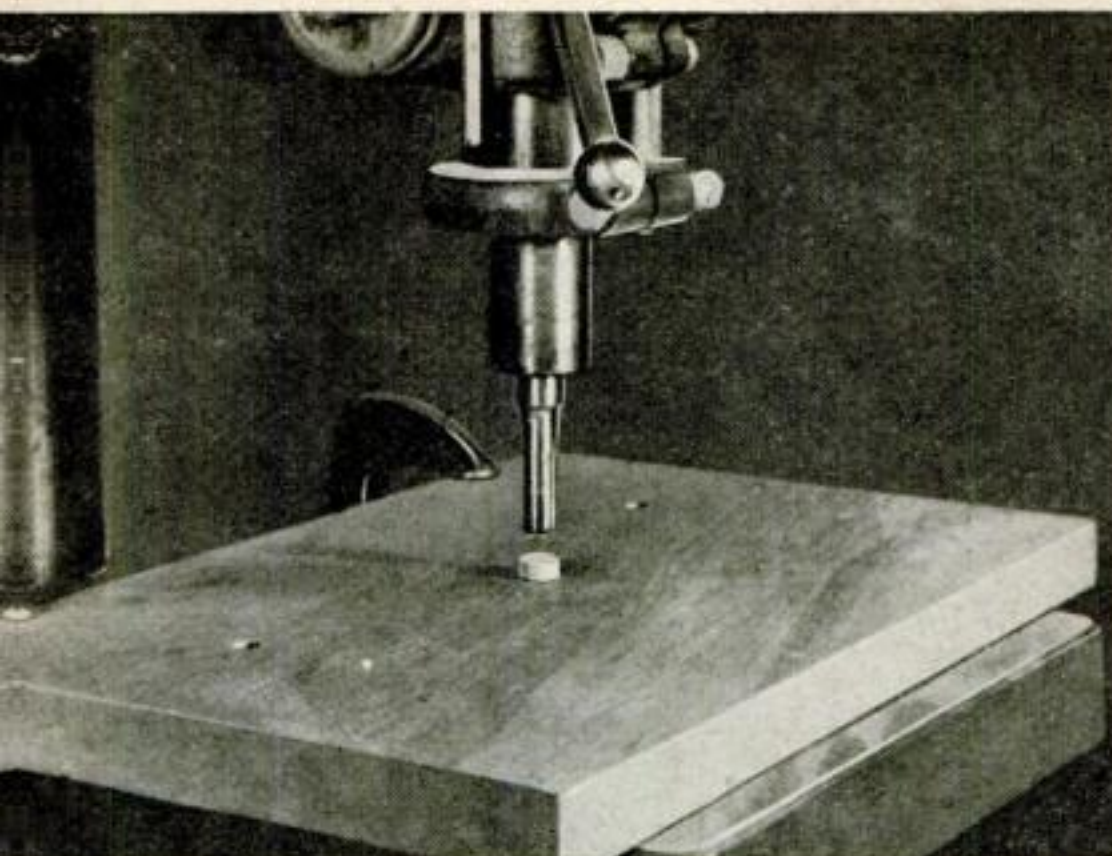


**Holes in dowels** usually are difficult to drill because the work rolls. This may be overcome with a V-block. Adjust the block so that the drill point is directly over the bottom of the V and clamp the block to the table to keep it in alignment while the dowel is being drilled.

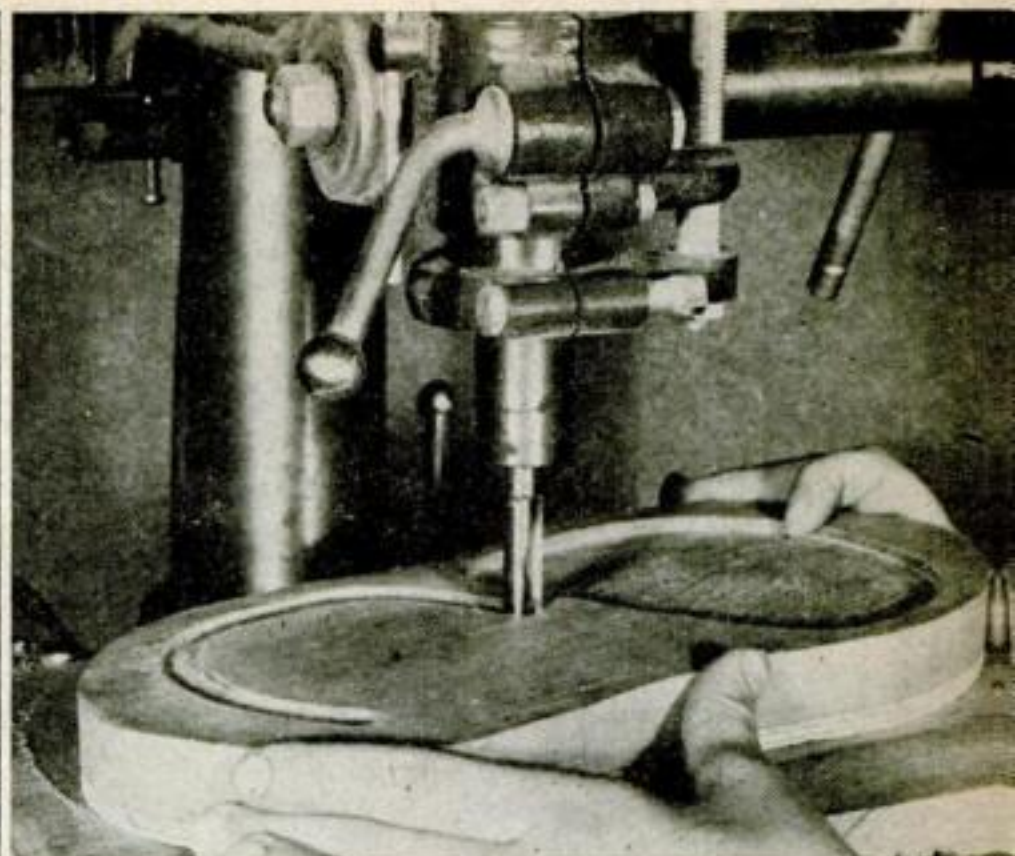


**A disk** also presents a problem when it comes to drilling a hole along a diameter. Again a V-block is the solution. Cut it from stock that is about as thick as the disk, set the table vertically, and clamp the block so the point of the V is aligned with the drill.





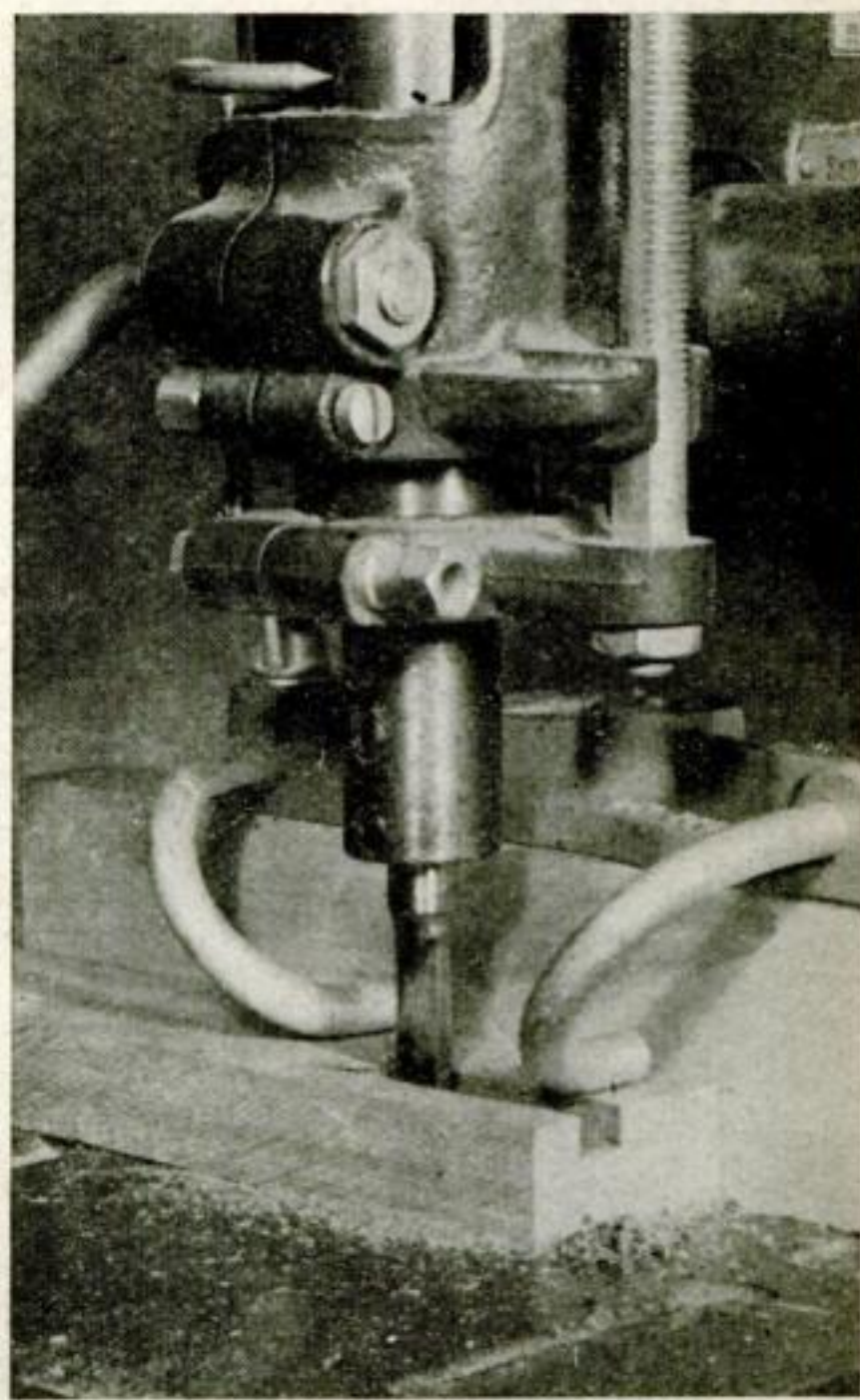
... Use a peg the same diameter as the bit and let it project a trifle less than the thickness of the pattern. Line up the peg under the bit, clamping the piece of wood in which it is set



to the drill-press table. Tack the pattern to the bottom of the work and place it over the peg. Make the first cut around the edge of the area to be routed. Then clean out the inside.

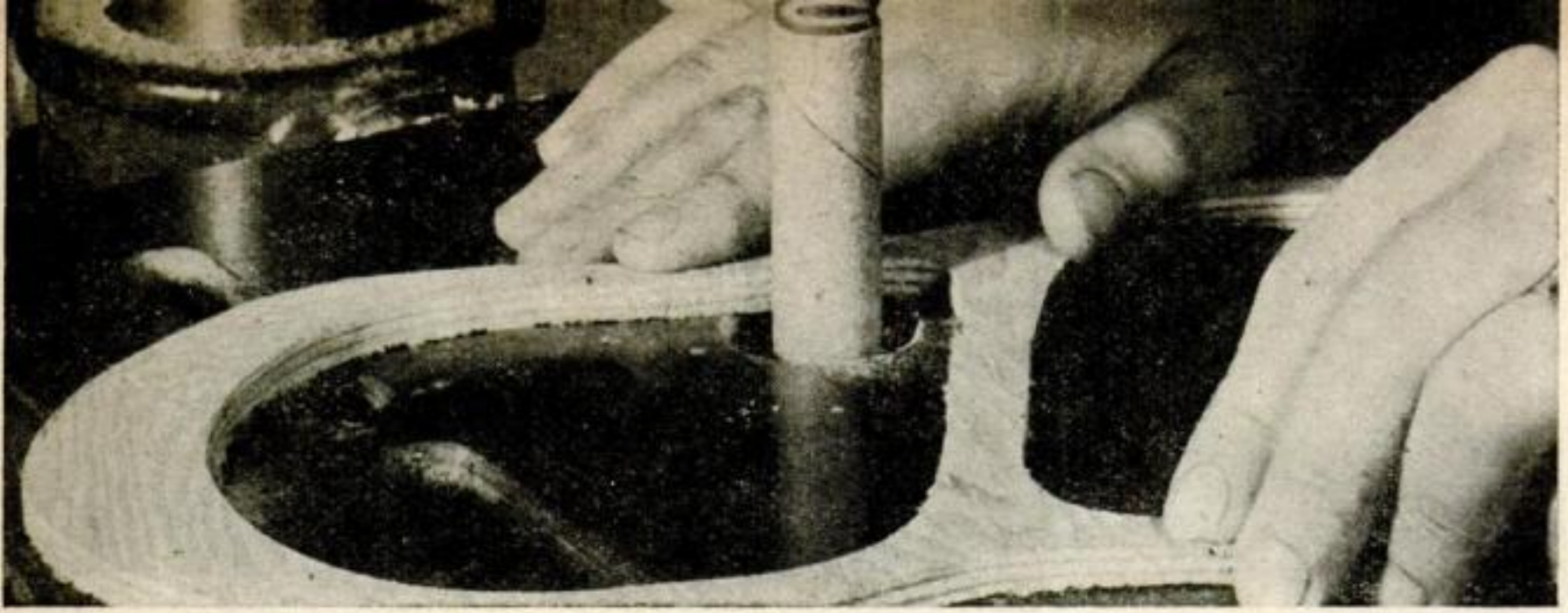


**Paint stirring** is one of the special jobs for which the drill press is well suited. Bend the end of a piece of stiff wire to a right angle and leave a shank long enough to extend from the chuck to the bottom of the can. To avoid spattering the paint, use a slow spindle speed.



**Drill-press routers** are excellent for either straight cuts or pattern work. Use the bit in a regular routing spindle. For a straight cut, it is a good idea to use a fence equipped with a hold-down, as above, if one is available. A high speed (about 5,000 r.p.m.) gives a good cut.



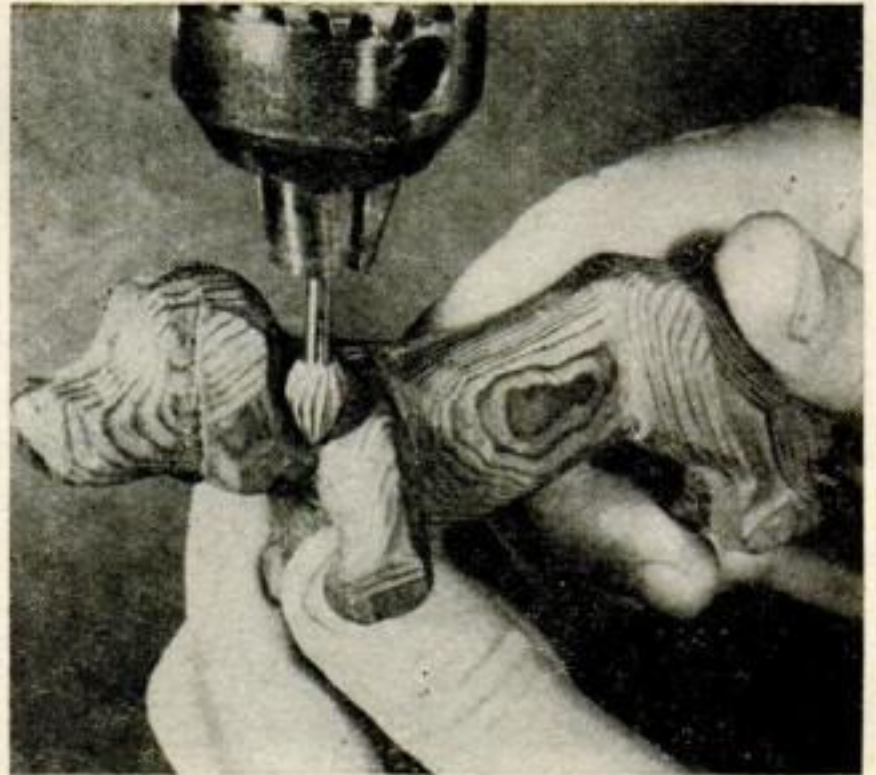


**Drum sanders** facilitate the sanding of curved edges. Since the sleeves are obtainable in a

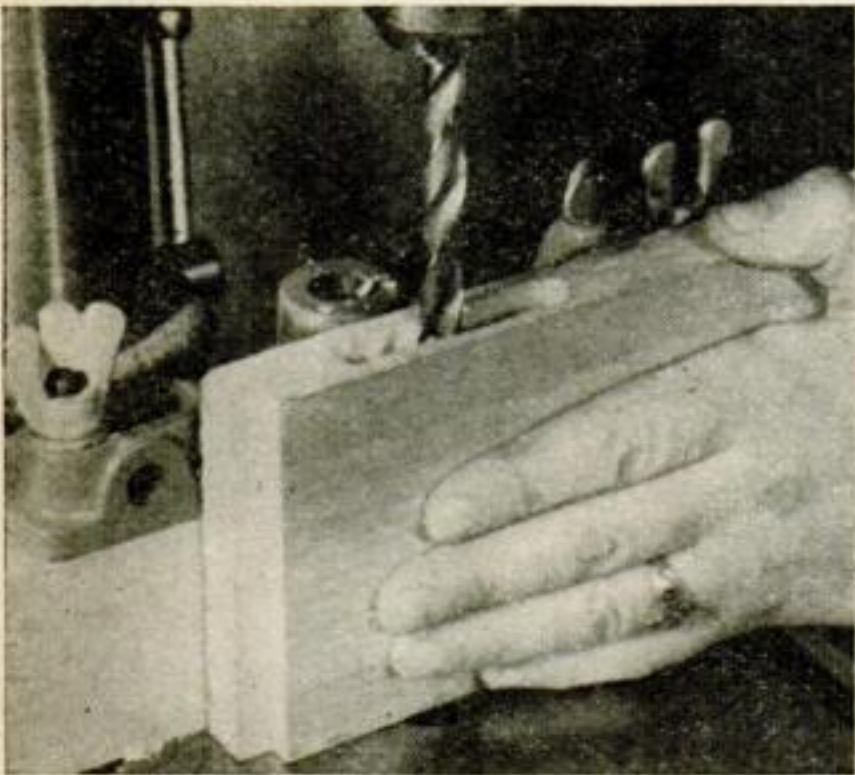
variety of grits, the entire sanding operation on a piece of work may be done on the press.



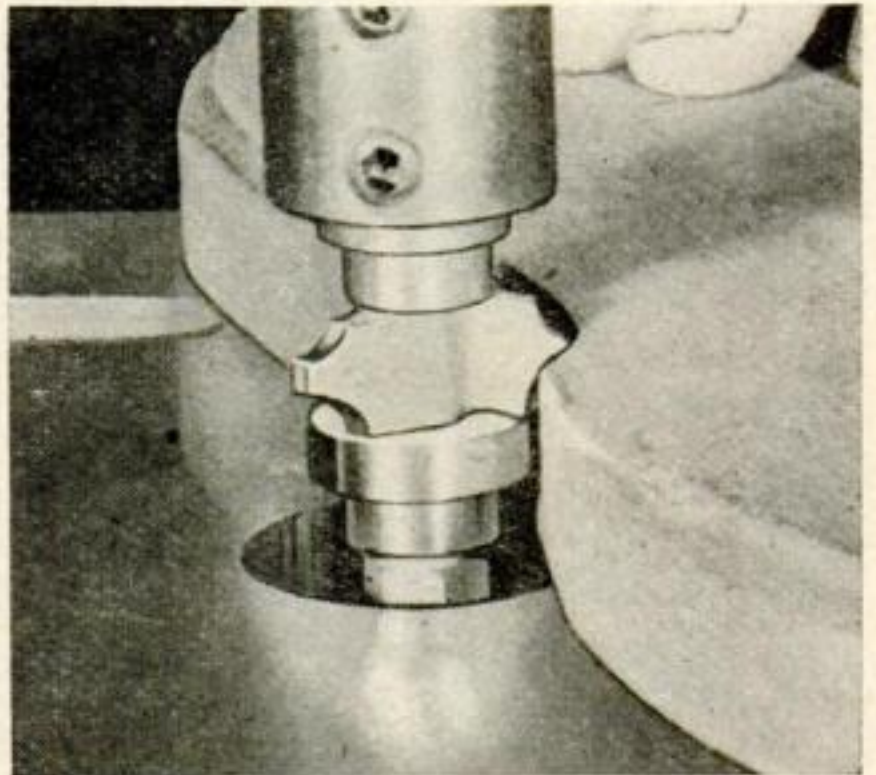
**Cloth buffing wheels** can readily be run on the drill press. Make a shank by cutting the head from a  $\frac{3}{8}$ " bolt. Then clamp the cloth wheel between two washers and nuts on the bolt.



**Carving** may be done by using the small burrs designed for hand grinding tools. This leaves both hands free to control the work. Run the press at high speed to get a clean cut.



**Round-end mortises** are easily cut on a press. Hold the work against a fence and drill a series of overlapping holes, beginning at the left end. Extend the bit to the bottom of the last hole, lock the quill, and move the stock against the drill to clean out between the holes.

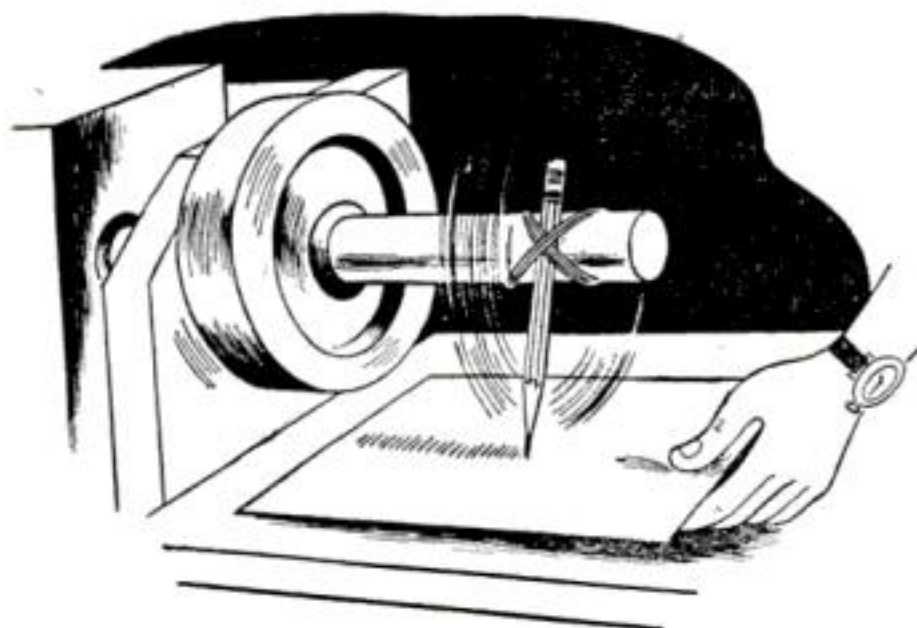


**If you lack a shaper**, you may do virtually the same work with a drill press. Set the table as high as possible so that the quill need not be extended. It is best to use only the cutters made for a drill press, for the larger shaper cutters exert too much side pressure.

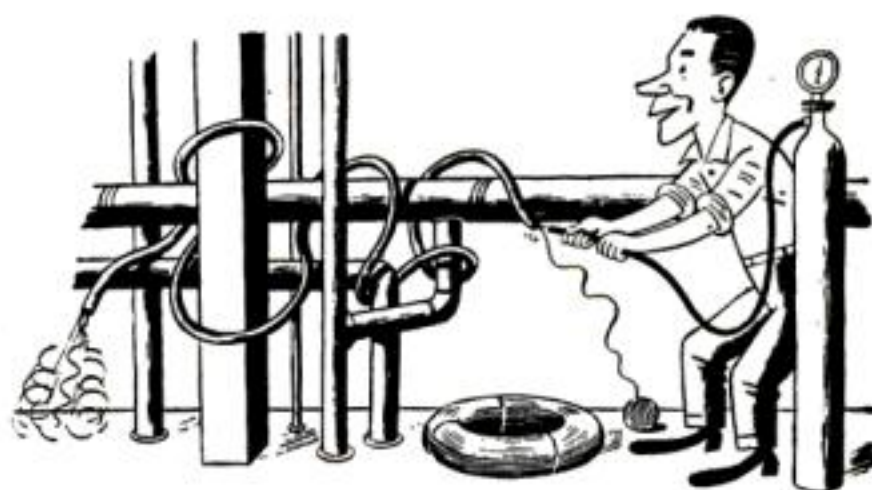


## WHAT'S YOUR I.Q.?

**It Burns Me Up** to read about people who set fire to good mattresses by smoking in bed. But I like to smoke in bed. Not caring to burn up, I got the base of an old gooseneck desk lamp, a two-part cigarette holder, and some plastic tubing. The tubing runs through the lamp-cord holes in the base. On the short end above the base I stuck the front end of the cigarette holder. The mouthpiece goes on the far end, and that's where I go. If I doze off while smoking, all's well.—SPEC COWDEN.



**Take a Tachometer**, if you have one. But if you haven't, here's a way to measure low shaft speeds. Slide the cardboard under the pencil for exactly 10, 15, or 30 seconds. Then count lines and multiply by 6, 4, or 2 for the r.p.m.—F. STRASSER.



**Here's a New Twist** on getting wires through awkwardly curved conduit. We had to put four conductors through a long piece shaped like a pretzel. The usual snake wire couldn't get by. Finally we used compressed air to shoot through some light cotton string. With this we pulled through the snake, and with that the wires.—L. PROVENZ.



**Blockheaded Ice Cubes** wouldn't go into the round neck of my lunch-time thermos, and, by letting them melt enough to fit, I'd waste most of the ice. So I cut some 1" aluminum tubing into 2" lengths and used them as molds for ice. The round "cubes" are a fine fit for the thermos. So my drink stays cold.—VICTOR E. ELIASON.

Have you pulled off a smart one lately? We will pay for acceptable contributions showing ingenious solutions of problems in the home, shop, garage, or camp. It doesn't matter if it's wacky—if it works.





## Turned Bowl Serves Bonbons to Music

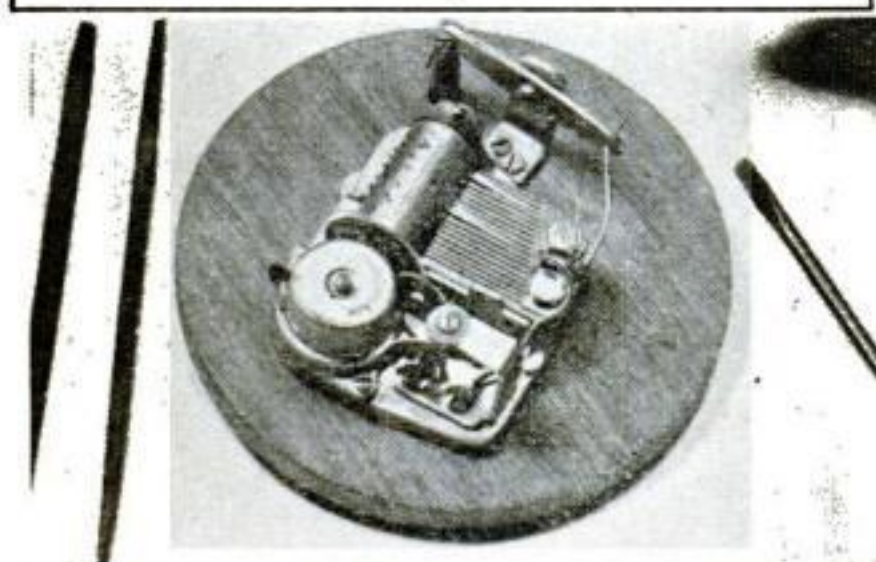
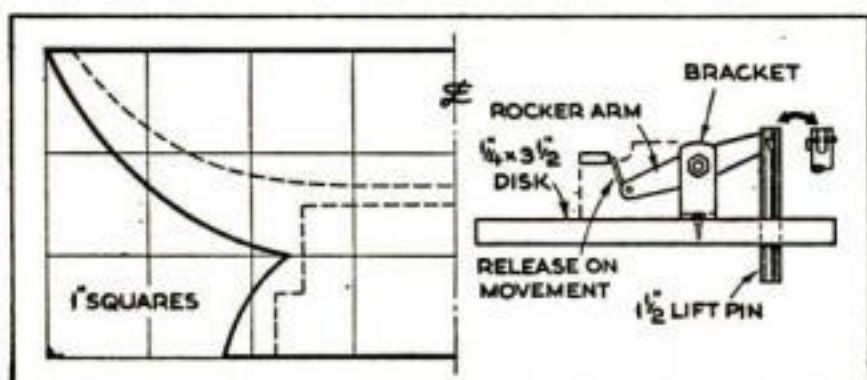
**W**HEN you pass the candy in this turned bonbon bowl, a Swiss music-box movement strikes up a tinkling tune. The music stops when the bowl is returned to the table. It's shown in color on page 136.

Mounted on a sounding board, the music movement is concealed in a space hollowed out of the base of the bowl. Ordinarily, such movements start when a weight is lifted and stop when it is replaced, but the action is reversed here by addition of a small bracket, rocker arm, and lift pin. Placing the bowl on a flat surface pushes up the pin, the rocker arm depresses the trigger, and the movement is turned off. When the bowl is picked up, the weight of the pin pulls down the arm, and the music is allowed to play.

Make the rocker arm and bracket from 16-gauge sheet brass and use a  $1\frac{1}{2}$ " length of  $\frac{3}{16}$ " drill rod as the pin, slotting the end to take the rocker arm.

Turn the bowl from a 3" by 8" disk of hardwood. Screw the block to the faceplate, rough-turn to 8" diameter, and face. Next turn down a shoulder to suit the sounding board and cut a recess for the movement. Check contours with a template as the turning of the outside progresses.

To hold the work while the inside of the bowl is being turned, screw a block of hardwood to the faceplate and turn a stepped chuck that fits tightly in the recess diameters. Sand the entire bowl while it is still on the chuck, then shellac, and finally polish with paste wax.—DORIS ALLER.



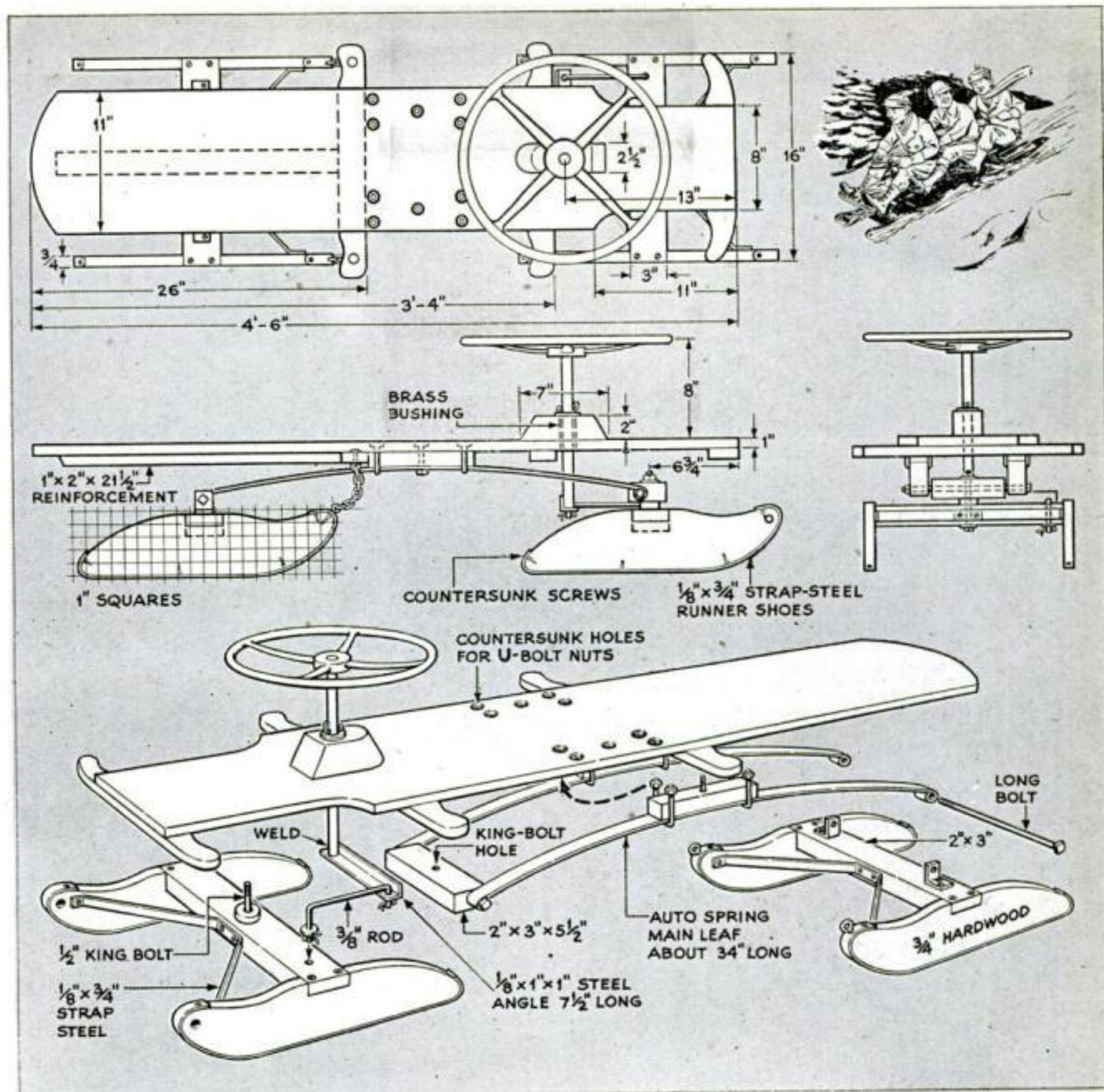
Cut a  $3\frac{1}{2}$ " disk from  $\frac{1}{4}$ " stock as the sounding board. Mount this with screws in the recess.



Turn the bowl from hardwood, first roughing it to 8" in diameter. Then turn out a recess for the movement. In turning the outside, use a

template as at center above. A hardwood spindle chuck turned to fit the bottom recess (right) holds the work as the inside is turned.





Two main leaves from an old auto spring provide a cushioned ride on the roughest hill.

## Three-Place Bobsled

**B**EFORE the snows come this winter, why not make this bobsled ready for the first fall? Carrying up to three persons, it's sprung on all four runners to give a smooth ride whatever the speed.

For the springs, select a pair of long main leaves from any light make of car at a wrecking yard. Secure each to the seat plank with two U-bolts over a block, countersinking the nuts flush with the plank surface. Also pass a carriage bolt through the hole in each leaf, the block and the plank.

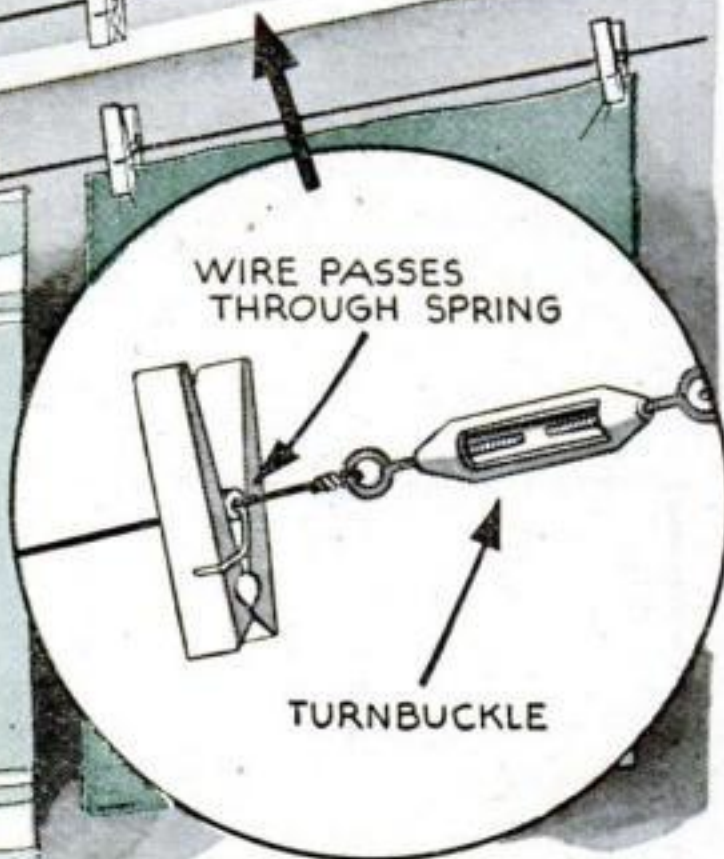
Each truck is braced by a length of strap iron installed diagonally. The rear truck is kept from swinging wide by chains that run from screweyes at the top front of each runner to the rear footrest. A 1" by 2" by 21 1/2" reinforcement is desirable under the overhanging rear portion of the seat plank.

The sled is steered by means of an arm welded to the bottom of the post and linked to the outer end of the front-truck beam. If available, an old auto steering wheel might be used here. A cotter pin over a washer keeps the steering post in place, and the post turns in a brass bushing.

By substituting wood axle beams for the trucks and putting on coaster wheels, you may easily convert the sled into a speedy summer coaster wagon.—HI SIBLEY.



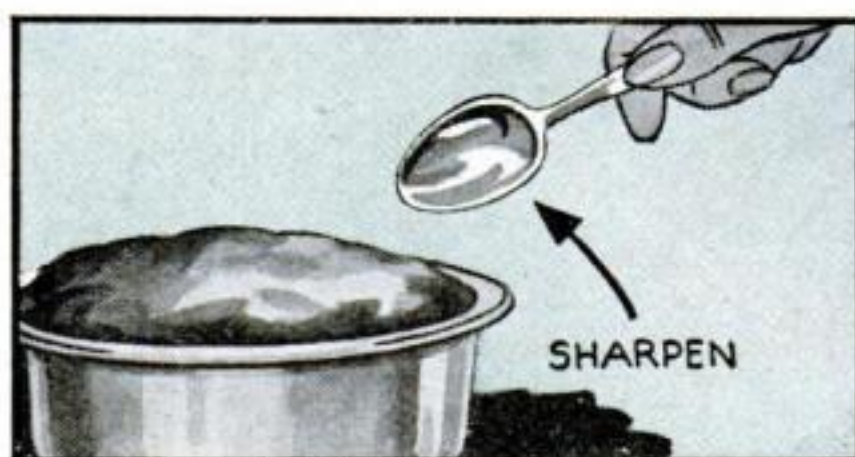
## KEEPING the HOME SHIPSHAPE



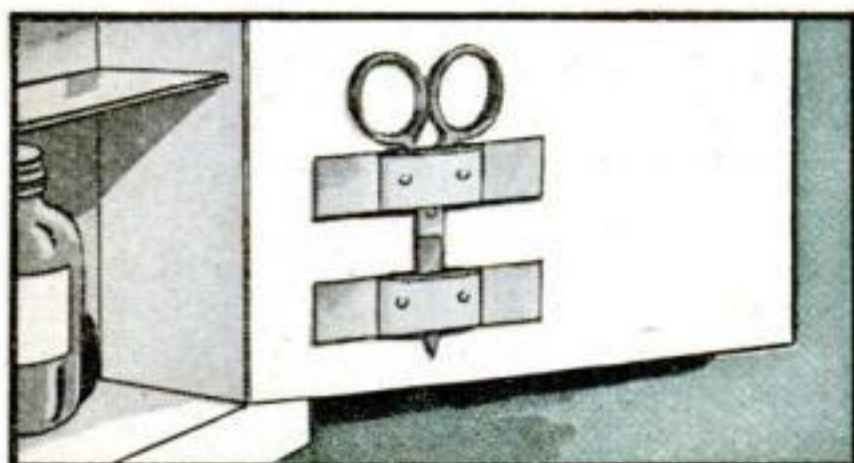
**Spring-type clothespins** strung on a wire line won't get lost. Several such lines, installed parallel to each other in the basement, are a convenience for drying clothes on rainy days.



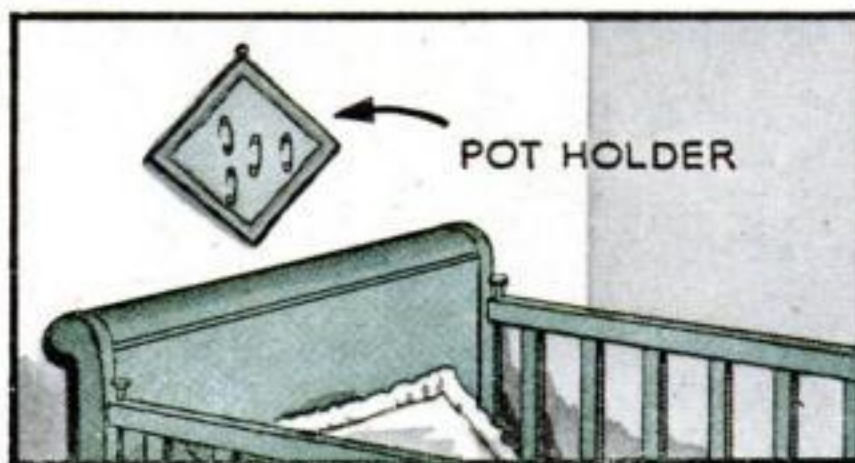
**Instant coffee**, being a fine powder, tends to heap on the spoon so that too much is used. By cutting away just half of the seal found under the lid you'll have a handy leveler.



**When cutting portions of puddings, fruits, hard-topped casserole dishes, and the like**, a serving spoon with one edge sharpened will make the work easier and the results neater.

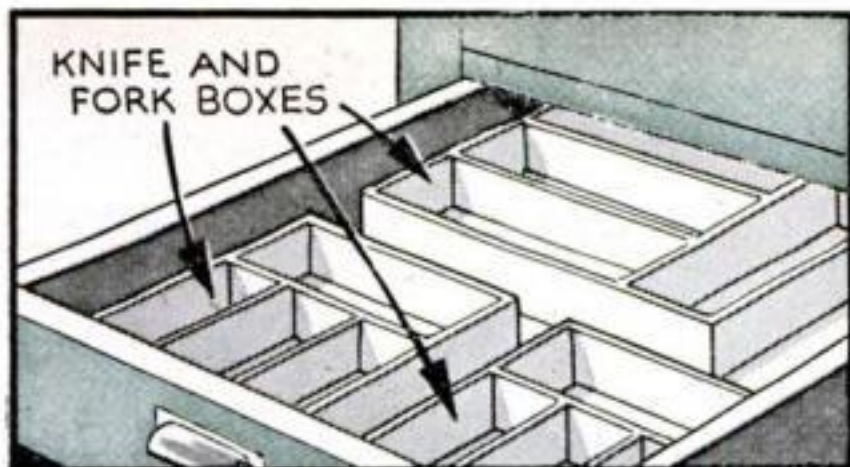


**A pair of scissors** may be kept at hand in the bathroom by making a holder from two adhesive bandages. Attach the holder inside the door of the medicine cabinet or under a shelf.

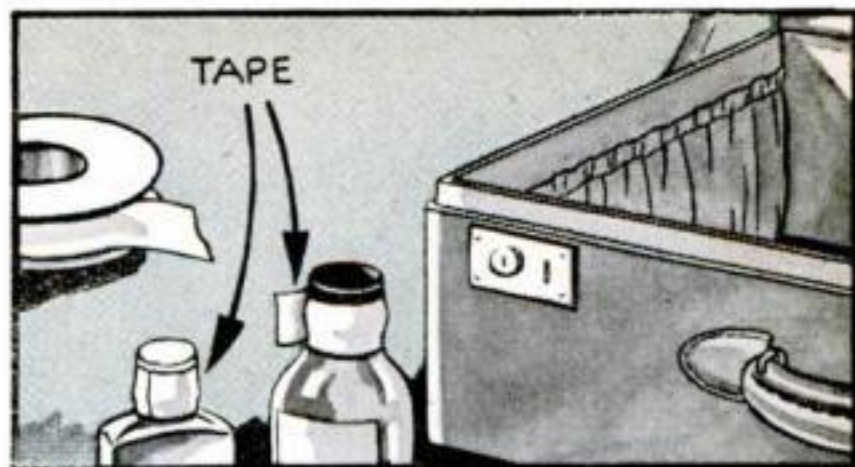


**A decorative pot holder** attached to the wall several feet above the crib or dressing table provides a handy and safe place to park open safety pins while changing a baby's diaper.

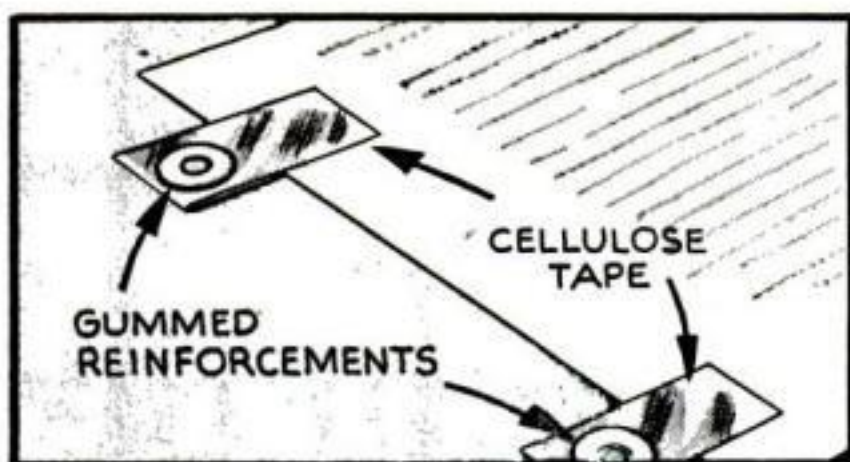




**Silverware boxes** sold in dime stores provide an efficient way of partitioning large bench and desk drawers for storage of small tools, desk supplies, and other miscellaneous gear.



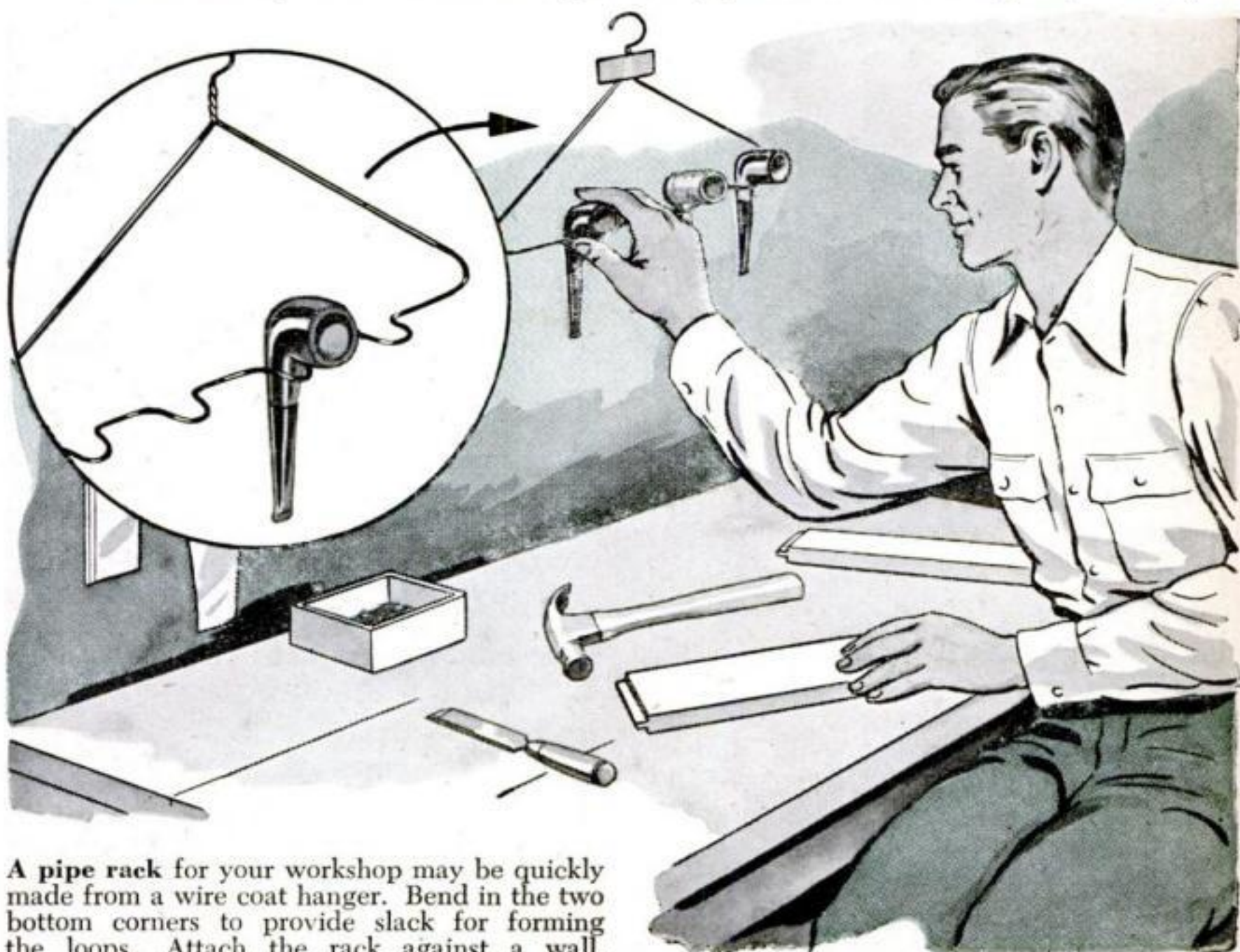
**Adhesive tape** wound tightly around the top of the bottle will prevent nail polish, perfume, and other liquids from being spilled in your bag. Carry a roll of tape for the purpose.



**Sheets of paper** that can't be punched because of insufficient margin may be mounted in ring binders as seen above. Use two reinforcements inside each of the strips of folded cellulose tape.



**When painting**, make the first coat slightly off color by stirring in a little paint of a different color. Then, in applying the second coat, you can avoid leaving unpainted spots.



**A pipe rack** for your workshop may be quickly made from a wire coat hanger. Bend in the two bottom corners to provide slack for forming the loops. Attach the rack against a wall.



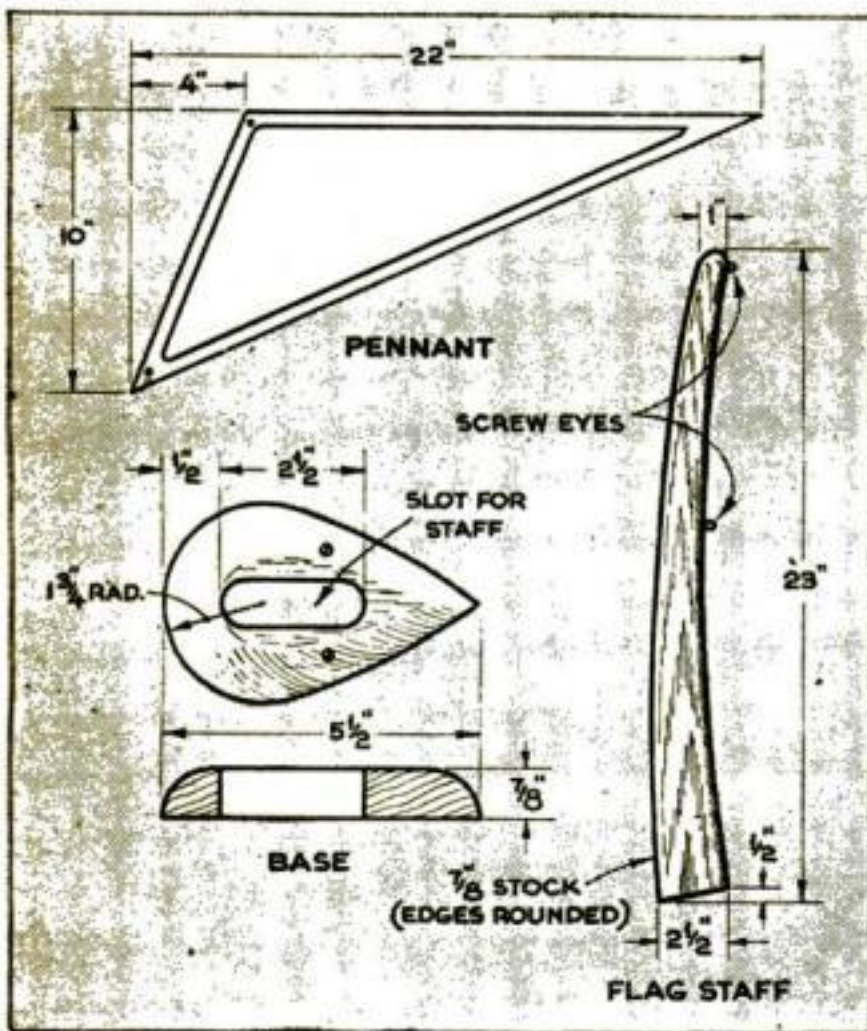
# For Boats and Boating



**Pontoons Stabilize Boat.** An outrigger unit consisting of two pontoons on telescoping steel arms is made by the Lee-Neal Company, Minneapolis, Minn. The rubberized-fabric pontoons are easily inflat-

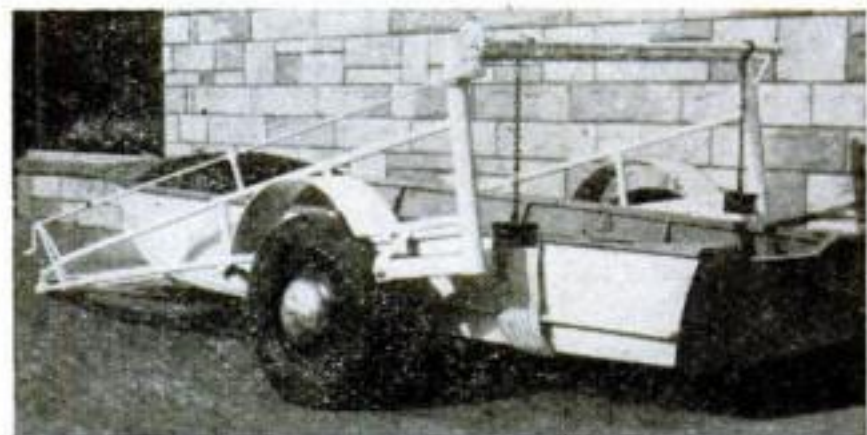


ed by mouth, and clamps attach the arms to the boat. For passing through narrow channels, the pontoons may be quickly brought inboard. The 18-lb. unit is designed for a duckboat, canoe, or rowboat.



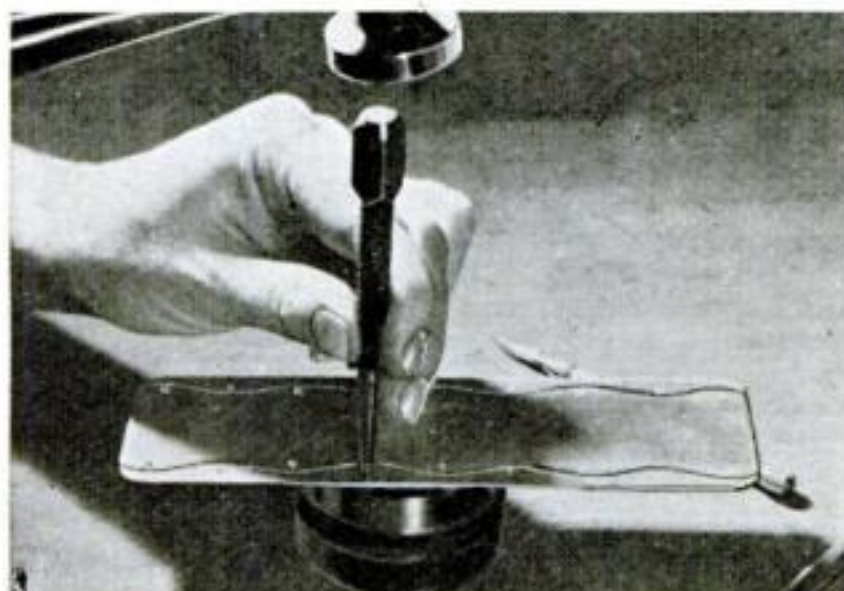
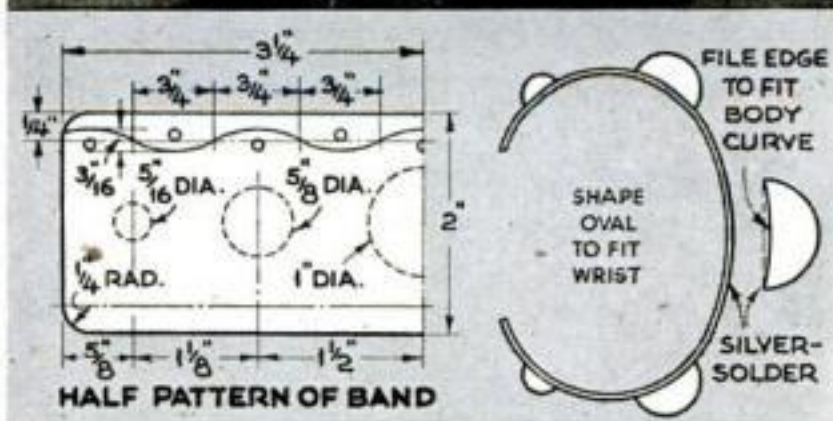
**Staff Flies Pennant.** For the best appearance, use walnut or mahogany in making this pennant staff. Cut out paper templates of the staff and base, transfer to the wood, saw to shape, round the corners, and sand smooth. Cut a slot in the base for the staff and drill three holes for screwing to the boat. Assemble with waterproof glue and apply three coats of spar varnish. Cut a pennant as shown.—JOSEPH S. CORLE.

**Anchor Lift.** Consisting of a hand crank and reel, this anchor lift is light in weight and may be quickly clamped to the side of any small boat. Approximately 50' of anchor rope winds on the reel. The device is distributed by Auto Coach Sales, Inc., of Michigan City, Ind.



**Winch Raises Boat.** A boat trailer made by the E-Z Manufacturing Company, Omaha, Neb., is designed for one-man loading and launching of boats up to 16' long. A winch at the rear eliminates manual lifting, the stern of the boat resting in a canvas sling that may be raised or lowered with the winch. Two models of the trailer are made, one for boats with beams up to 64" and another for those with beams up to 54".





Indent the small circles with a nail punch. A chisel-shaped punch may be used for the lines.



Form the hemispheres with a round-nose punch and dapping die block. Three sizes are needed.

## Hand-Hammered Slave Bracelet

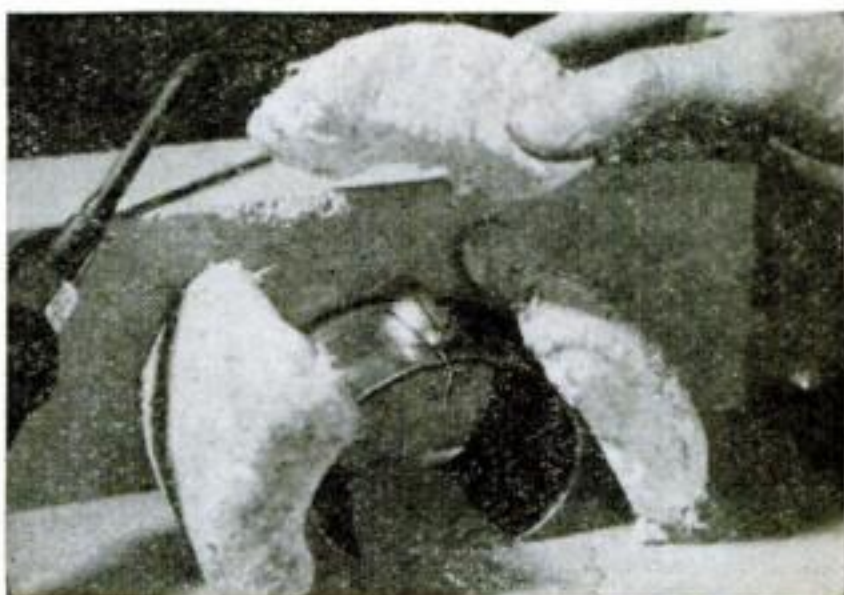
**A**LTHOUGH this bracelet has the heavy, massive appearance of the traditional slave type, it nevertheless is comfortable to wear because the hollow construction of the decorative balls makes it quite light.

The body requires a 2" by 6 1/2" piece of 18-ga. sheet silver, brass, copper, or craft alloy. Work out the edge design on paper full size, transfer it with carbon paper, and scribe locating circles for the balls.

A nail set may be used to indent the small circles, while a punch shaped like a small cold chisel will follow the curved lines. When the design is complete, round the corners and bend the bracelet to the oval shape shown in the drawing, leaving an opening just large enough for the wrist. Note the taper from front to back shown in the photo above.

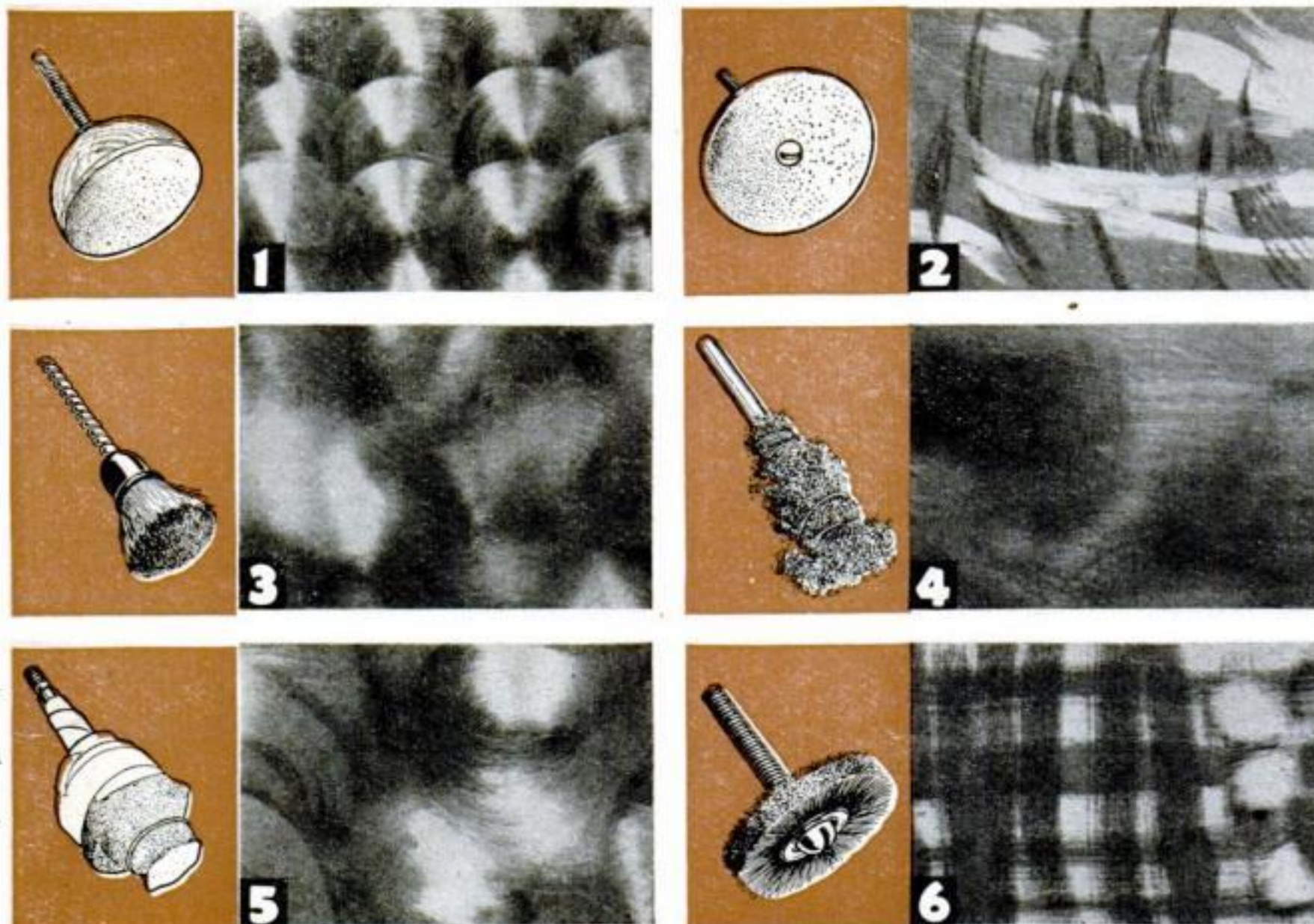
Form the hollow hemispheres from 18-ga. disks, using a dapping block and round nose punch or, lacking this, steel balls and a hollowed hardwood block. The large knob requires a 1 1/4" disk, the others 3/4" and 7/16" disks. File the bottoms of the hemispheres to fit the curvature of the bracelet where they join. Remove all hammer marks with a fine file and abrasive cloth.

Fine wire twisted around the band and the balls will keep them in place for silver-soldering. Solder one at a time. Soft soldering will do if you use a small torch and work carefully with a minimum of solder. After scraping off any excess, polish the bracelet with progressively finer abrasive cloth. Finish with jeweler's rouge applied with a soft cloth or a clean soft buffing wheel.—W. A. CONWAY.



Asbestos pads help to conserve the heat for silver-soldering with a low-temperature alloy.





Various decorative effects and the attachments used to produce them are illustrated above.

## ***Electric Drill Creates Novel Metal Finishes***

**M**ETAL projects or objects already in use in the home may often be improved in appearance by finishing the metal in various effects and patterns. An electric drill or drill press and a few simple accessories are all the equipment needed for such work.

Any soft metal—aluminum, copper, brass, and some alloys—may be given the finishes above by the methods suggested in this

article. Harder metals would require tougher abrasives. This is how the decorative effects shown may be produced:

1. An emery pad will yield overlapping circles like these, the pad being applied with even pressure in a regular pattern. Polish with fine steel wool and light oil. The size of the pad determines the size of the circles. Such an attachment may be made by cementing a disk of leather or felt, and then a disk of emery paper, to the end of a wooden dowel section into which you have glued a smaller dowel to fit the chuck of the drill. Or, you might use a bolt that fits the chuck, countersinking its head into the dowel section and then cementing on the disks.

2. An emery disk was applied edgewise here with even pressure. It consists simply of an emery-cloth disk backed with another of cardboard, both clamped by a nut against the head of a bolt that serves as a shank.

3. A brass brush, varying pressure, and



Steel wool mounted on a split-dowel shank in an electric drill decorates soft metal.



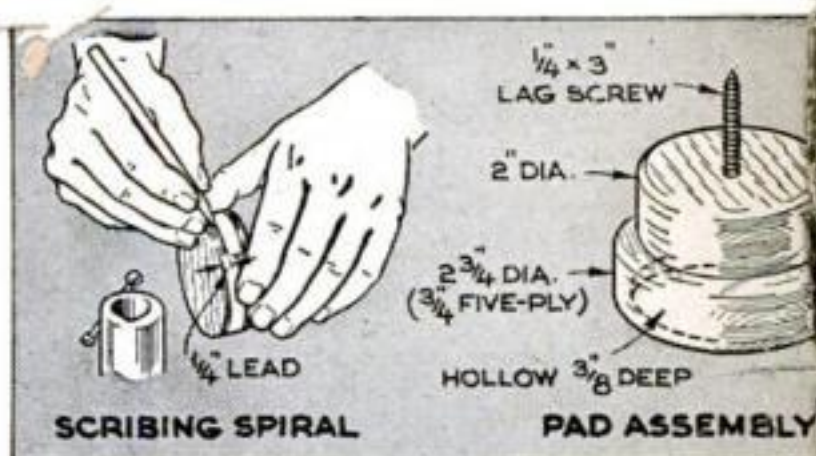
an occasional slide added up to the smoky whirl of these overlapping circles.

4. Drawing the metal back and forth across the end of a steel-wool pad in irregular sweeps gives the effect of graining. Make this pad by turning a dowel to fit the drill chuck, splitting the dowel on one end, and inserting some of the wool in the split before wrapping with soft wire.

5. Here, the edge of an emery roll was applied with heavy pressure in semicircular sweeps. Polish with fine steel wool and light oil. Make the roll by wrapping and taping emery paper over a steel-wool pad made as in the foregoing paragraph.

6. An ordinary wire brush offers a variety of good possibilities for straight-line effects.—R. J. DeCristoforo.

## Jar Ring Clamps Polishing Pad for Drill Press



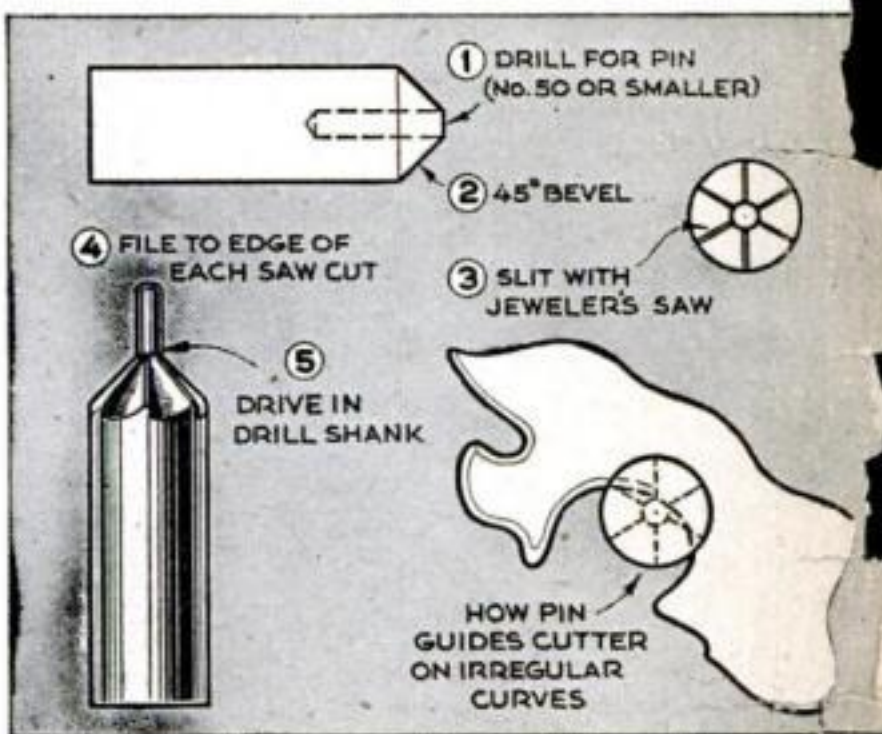
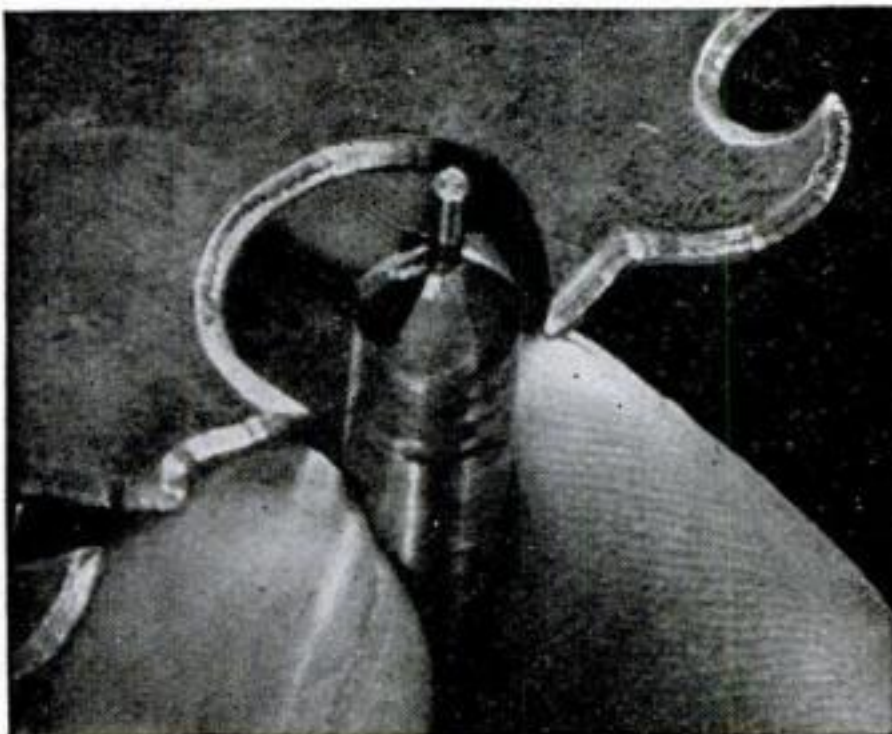
A THREADED jar ring clamps the pad of steel wool used in this efficient polishing head. For the pad assembly, turn two disks from  $\frac{3}{4}$ " plywood, one  $2\frac{3}{4}$ " in diameter and the other 2". Hollow the face of the larger to allow space for the steel-wool pad.

Scribe a spiral line on the edge of the larger against a strip of cardboard wrapped around it with the ends offset  $\frac{1}{4}$ ". Then,

with a small gouge, carve a thread suitable for the jar ring. If the fit proves too loose, drive small brads into the thread, allowing the heads to project slightly. A lag screw locks the disks together and serves as a shaft.

Form a pad of steel wool with the fingers, turning the edges under. Place it in the ring and screw the ring partly down, turning under any loose ends.—EDWIN M. LO

## Small Cutter Bevels Edges on Irregular Shapes



GUIDED by the pin, this drill-press cutter follows an edge on irregular work, beveling as it goes. It was mothered by necessity while I was making brass escutcheon plates.

The cutter may be made from a 1" length of  $\frac{1}{4}$ " or  $\frac{5}{16}$ " drill rod. Chuck in the lathe and drill a hole one size smaller than the

drill shank you intend to use as the pin. Then turn a 45-deg. bevel, mark off six equal spaces, make slits about  $\frac{1}{32}$ " deep on these lines with a jeweler's saw, and shape six teeth with a file, sharpening with a fine file. After driving in the pin, harden and temper the cutter.—HERBERT PFISTER.

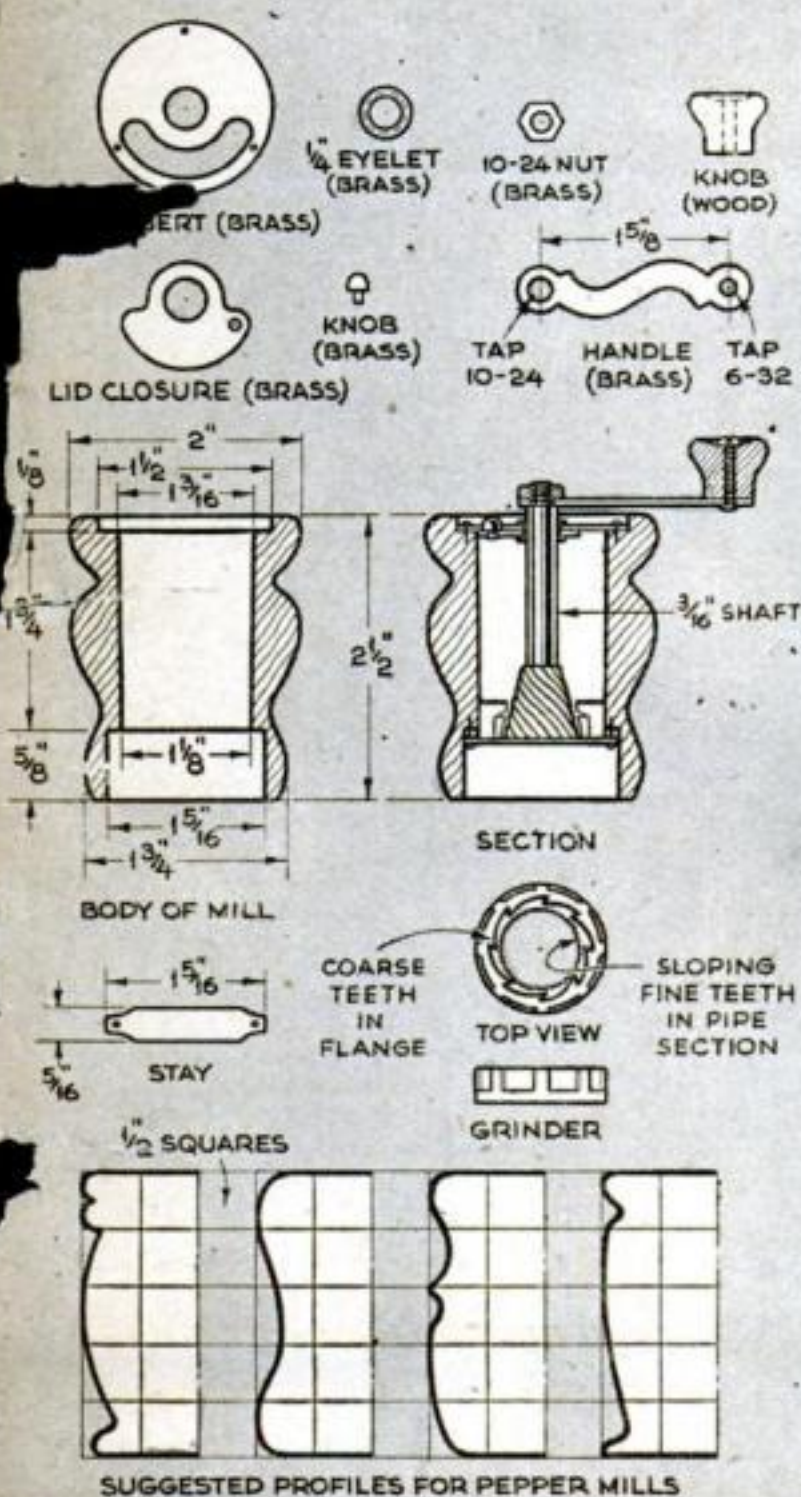




## HANDICRAFT FOR CHRISTMAS

For a gourmet's touch, add freshly ground pepper to your meals with this table pepper mill.

# Table Mill Grinds Fresh Pepper



**P**EPPERCORNS, the hard little seeds from which fresh, pungent pepper is obtained, can be ground directly over your plate with this traditional table mill.

Mount a 2 1/4" maple turning square on the screw center, support it with the dead center, and rough-turn the outside. Turn out the 1 1/2" top recess. Then slide away the tailstock and carefully bore out to 1 3/16" diameter about 1 1/2" deep. Now mount a bit of scrap and turn it as a tight-fitting mandrel for the 1 3/16" bore. Mount the reversed workpiece on this mandrel, bore through a press fit for the grinder, turn the lower recess, and finish-turn the outside.

File the lid insert, the closure, and the eyelet from light brass, but use heavier brass for the handle. The knob for the closure is simply a brass nubbin riveted in place. For the shaft, use a 2 3/8" length of 3/16" steel rod (solid curtain rod is often found in this size). Thread the upper end 10-24 for 1/4", and the lower 10-24 for 1 1/16".





All metal parts are filed to shape. A conduit bushing, lower left, is used for the grinder.

Turn the grinder head from a  $\frac{3}{8}$ " length of  $\frac{3}{4}$ " steel, tapering it from  $1\frac{1}{16}$ " to  $\frac{5}{16}$ ". Drill and tap it 10-24, screw it on the shaft, and peen the latter over. File spiral flutings around the head.

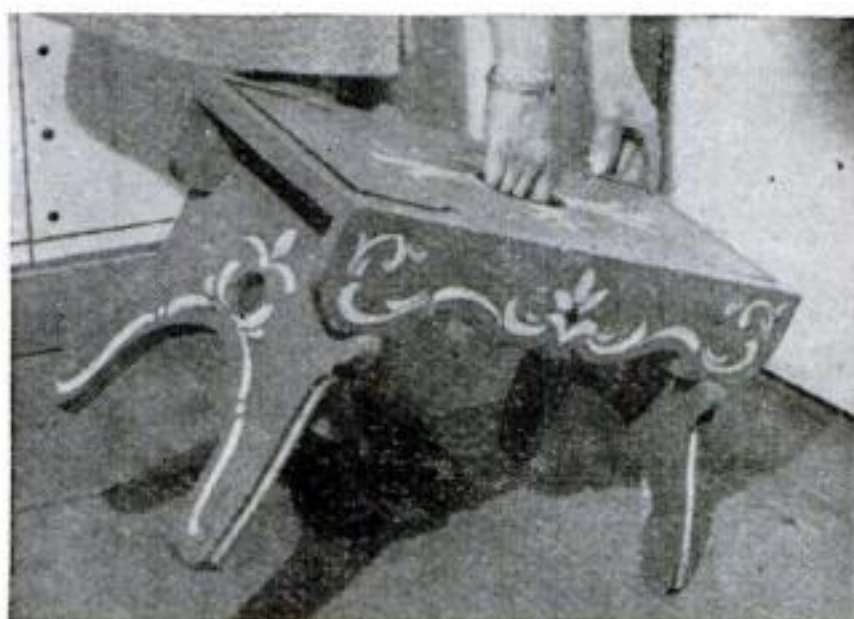
For the grinder, screw a piece of  $\frac{1}{2}$ " pipe into an electrical-conduit bushing and cut off the pipe flush. Around the lip of the



File spiral teeth in the grinder head with triangular file. Fit the wood knob to turn easily.

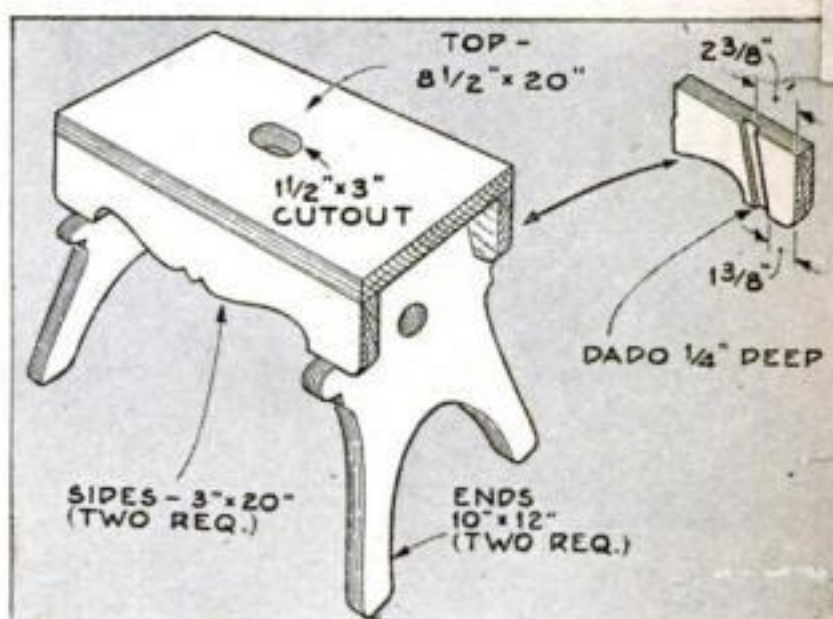
bushing file saw-shaped teeth. Inside the pipe, file many small teeth at an angle slightly less than the head taper. Press the grinder carefully into the barrel, tack the lid assembly to its shoulder with escutcheon pins, and insert the shaft and grinder head from beneath, securing it with a stay tacked across the bottom.—PAUL ALLER.

## Sturdy Footstool Will Bring You Solid Comfort



STURDY and decorative, this stool offers an excellent one-evening project. If necessary, it may be built entirely with hand tools. All pieces are cut from 1" stock.

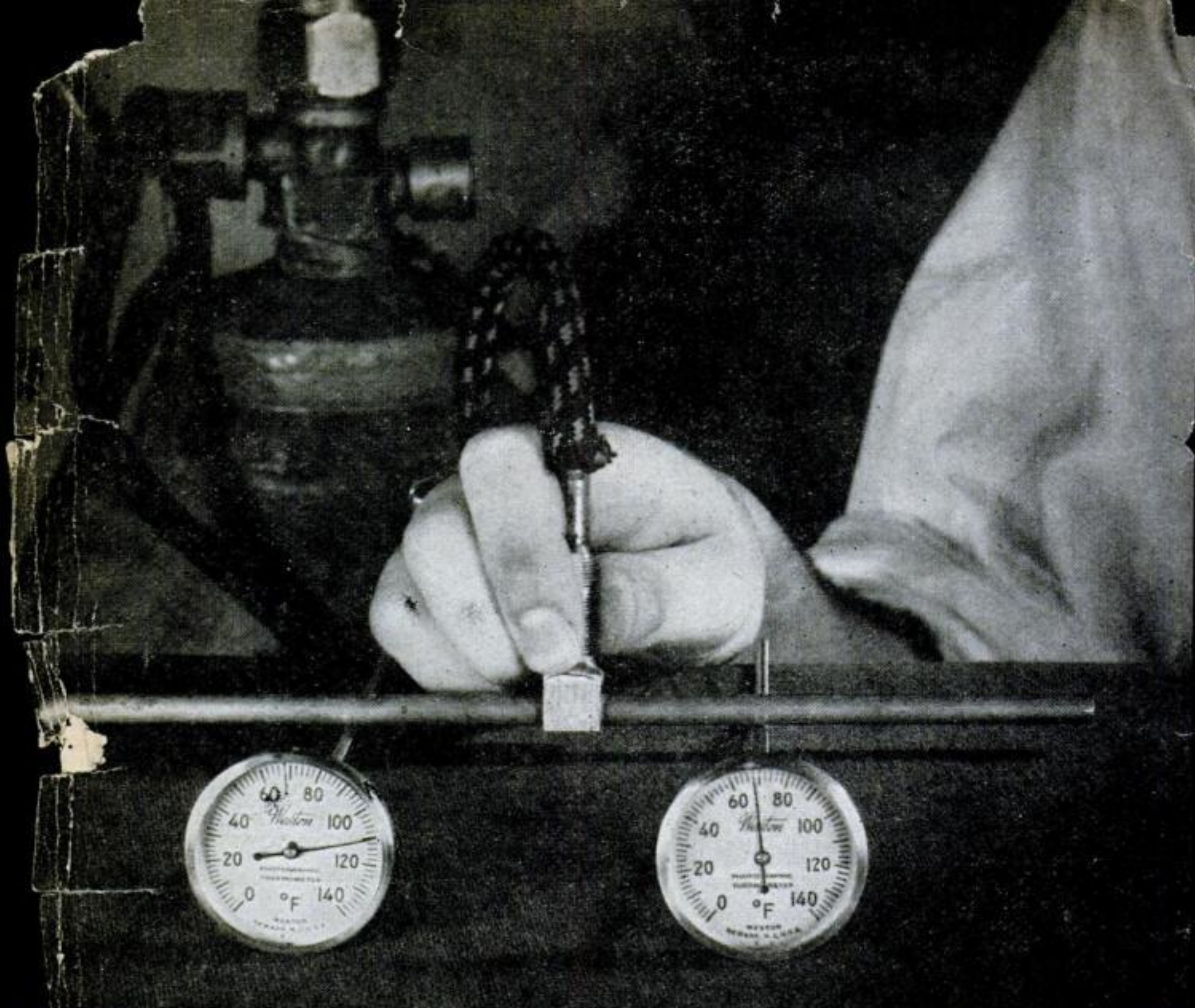
Shape the two endpieces to the freehand curves shown with a coping saw, making them about 12" long. Since these are at-



tached at an angle, the stool will be a bit less than 12" high when assembled. Slanted dados cut in the sidepieces bring the feet about 22" apart at the bottom.

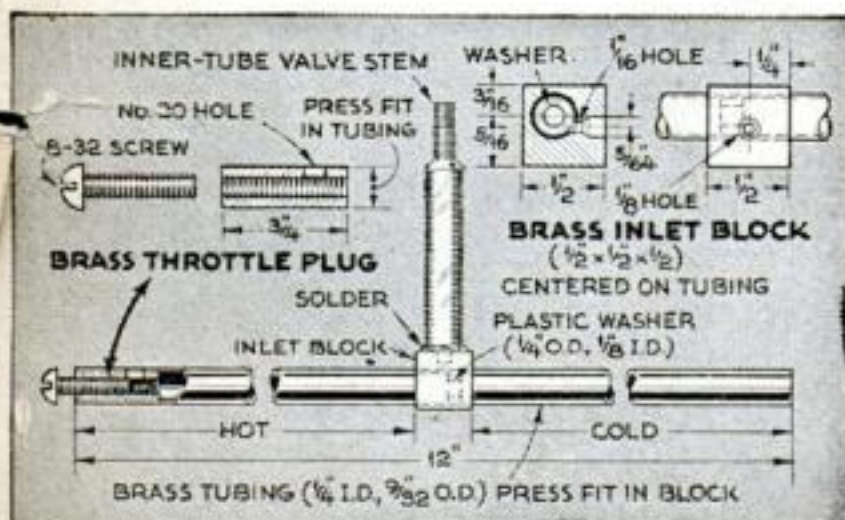
Assemble all the pieces by gluing and nailing. When the glue has set, decorate by painting as desired.—EDWARD R. LUCAS.





The left arm of this model of the mysterious Hilsch tube gets hot. The right arm grows cold.

# Homemade "Maxwell's Demon" Blows Hot and Cold



THE magic Hilsch tube that imitates Maxwell's imaginary demon by blowing hot and cold at the same time (PSM, May '47, p. 144) can be made at your own workbench and operated at the nearest gas station. A simplified version was designed for Popular Science readers at the RCA Transmitter Laboratory, Rocky Point, N. Y., where research on this curiosity of thermodynamics goes on.

PSM's Hilsch tube was made in a few

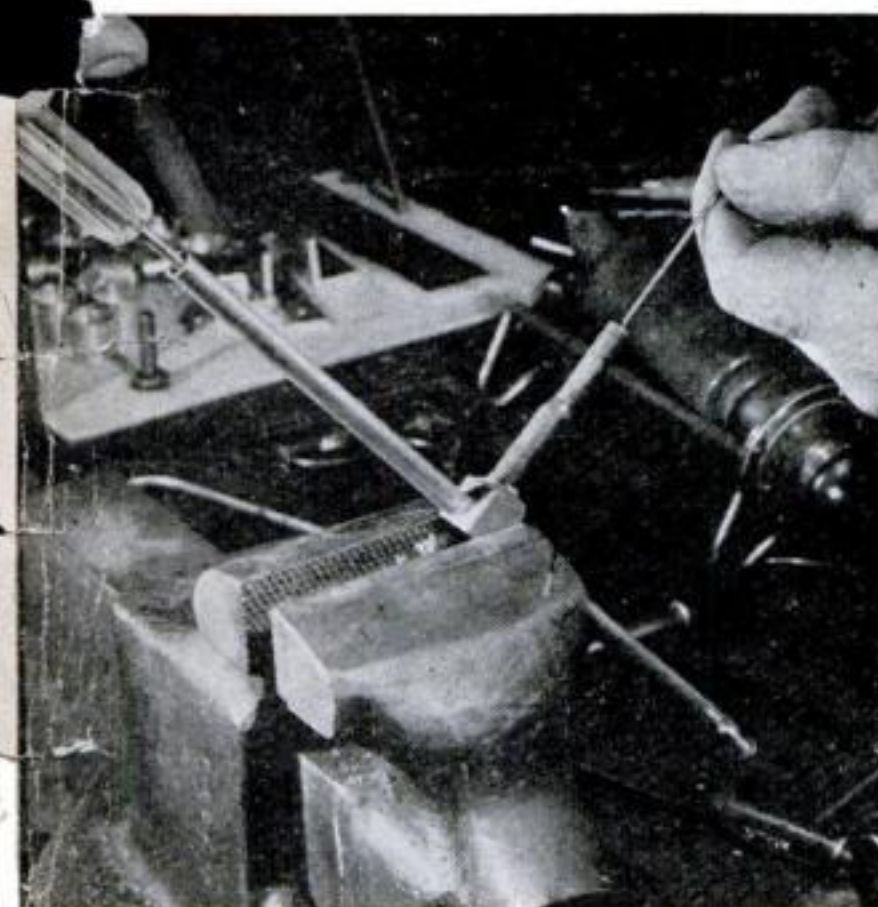




Now saw off the inlet block. Remove the valve from an inner-tube stem and cut off the base. Push a 1/16" drill through to align it with the hot hole and solder all around as above.



A plastic or wood washer (not metal) that will be a push fit in the tube is needed. The hole in it is about 1/8". Make the washer, if necessary, from a dowel or slice it off a tube.



Insert the washer in the tube, marking the end from which you do so. This will be the cold arm. Stick a 1/16" rod through the inlet and push the washer against the rod as above.



Cut a piece 3/4" long off some 1/4" brass rod. Drill through lengthwise No. 28 and tap 8-32. Press this into the hot end of the tube. Drill a No. 20 hole right through both tube and rod.

The cooling effect, would be automatically controlled by air speed and density, increasing as skin friction goes up, decreasing as it lessens.

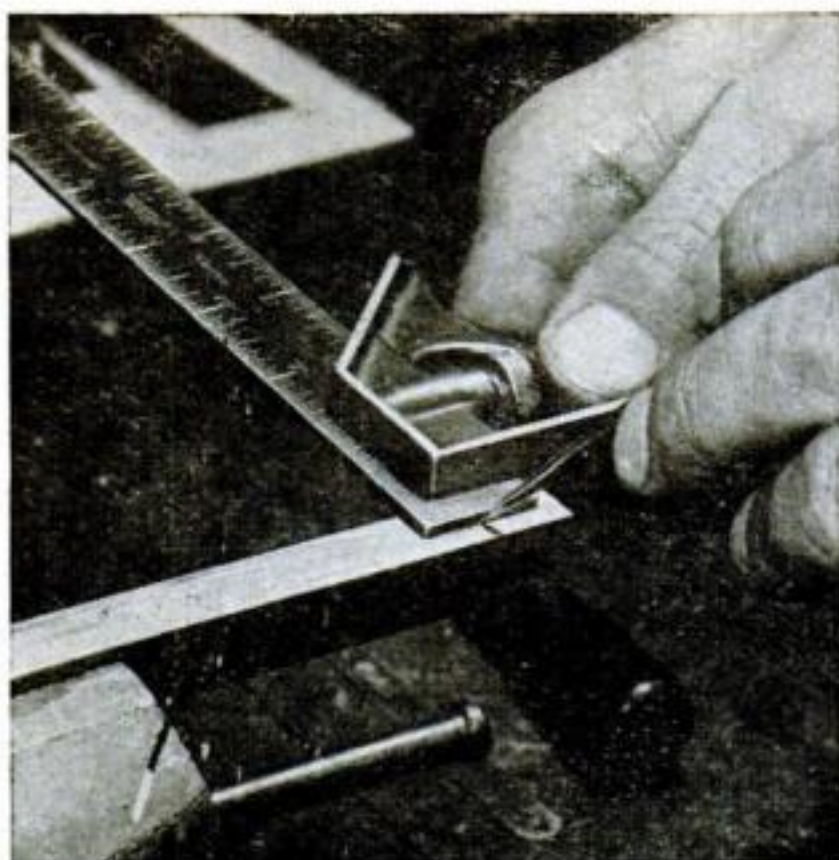
Although most of the dimensions shown in the drawing aren't critical, the location of the air inlet must be tangent to the inner wall of the tube to set up the whirlpool effect necessary to operation. The 1/16" inlet hole must be drilled just far enough to break smoothly into the tube, but not so far

as to nick the adjacent part of the wall. This might destroy the vortex effect desired.

If you can't find a suitable fiber washer or cut one off a fiber or plastic tube, drill a 1/8" hole in a slice of 1/4" wooden dowel.

The throttle is a short length of 1/4" rod tapped for the throttle screw. It's inserted in the hot end of the tube without the screw, and a No. 20 drill is run right through both tube and throttle. If it's too loose a fit in the tube, coat it thinly with solder. **END**

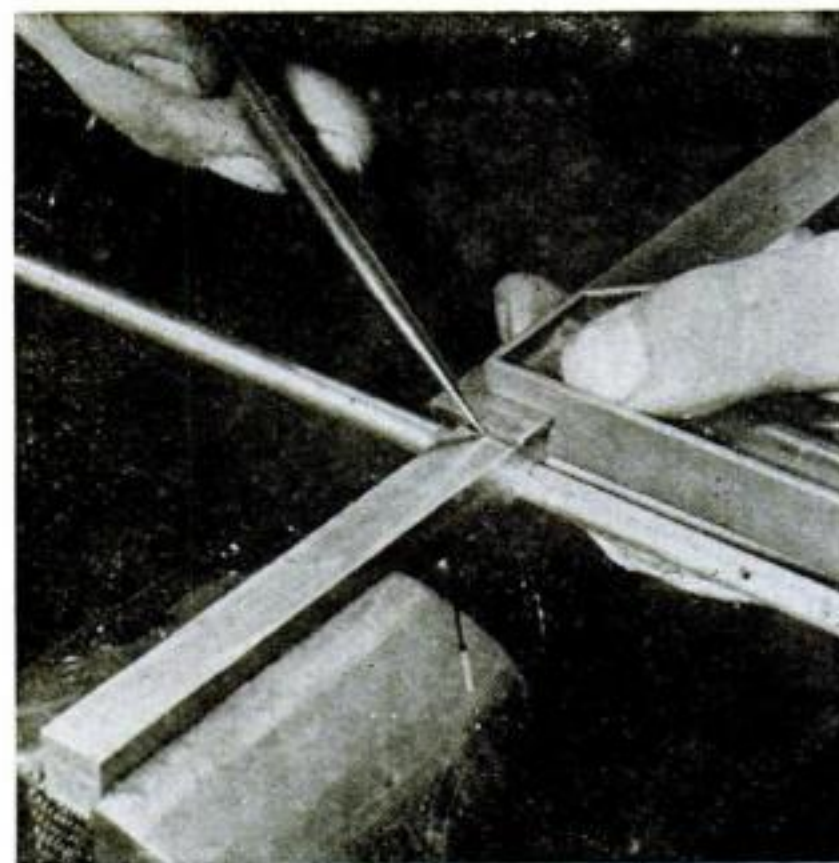




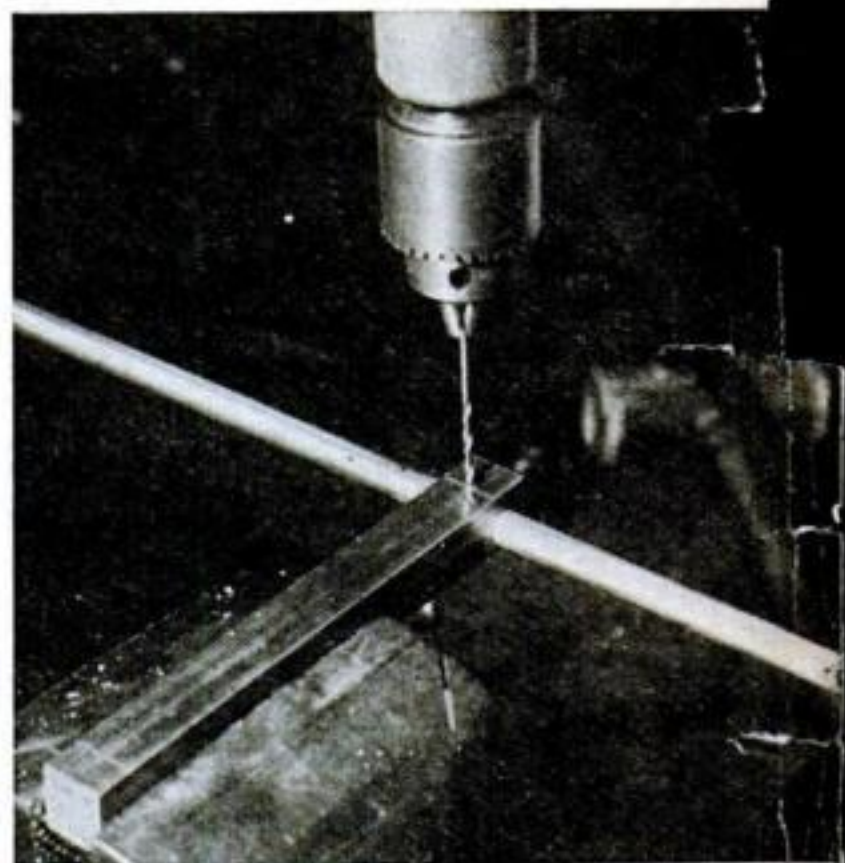
**Mark the location** of the 12" long tube on the  $\frac{1}{2}$ " square brass stock from which the inlet block will be cut. At this point drill a hole that will be a press fit for  $\frac{9}{32}$ " tubing.



**Carefully drive** the tube through the hole so that the two arms are approximately the same length on both sides of the inlet block. However, don't cut the block off as yet.



**Locating the inlet hole** is a crucial step. It must be tangent to the inner wall of the tube,  $\frac{5}{64}$ " from the center of the first hole, to create the necessary whirlpool effect.

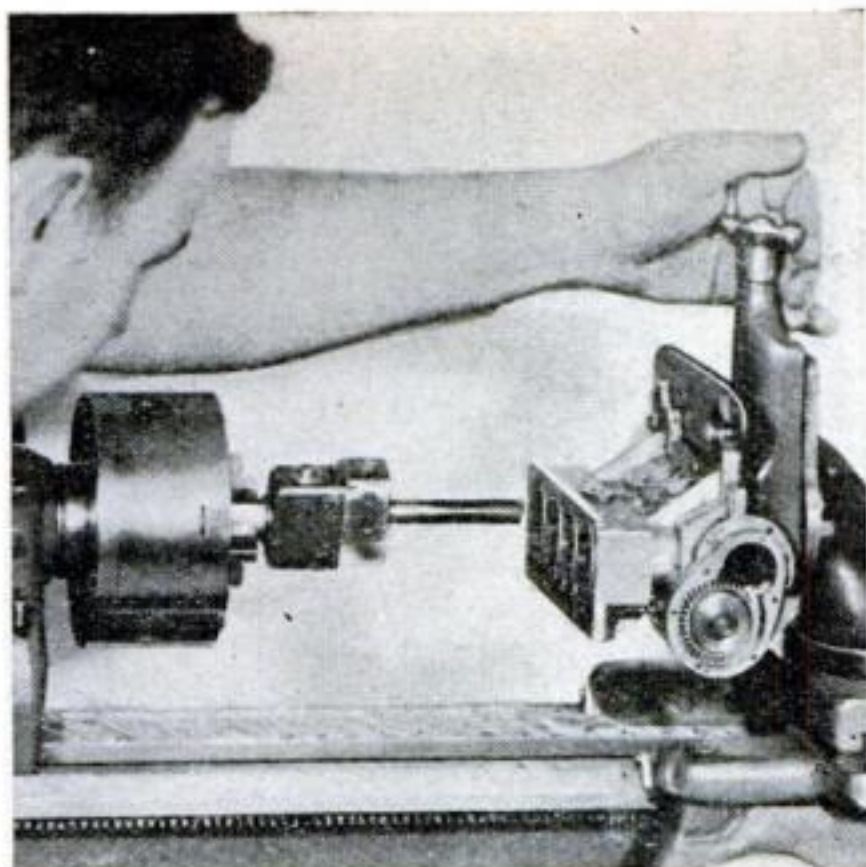


**Drill a  $\frac{1}{16}$ " hole** straight down, but only just through the tube wall. Drilling across the tube may cause it not to work. Counterbore the inlet hole  $\frac{1}{8}$ " to about half its depth.

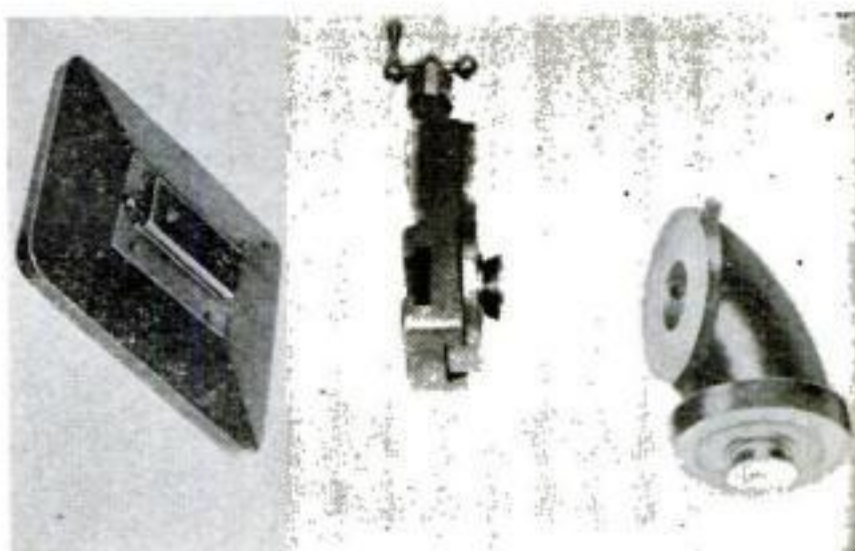
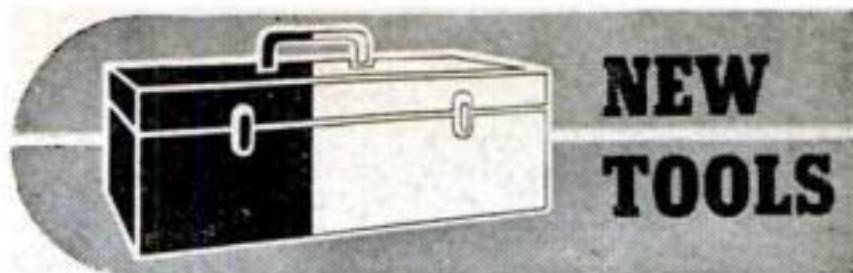
minutes with simple tools. When it was hooked to a filling-station air hose, one arm became too hot to touch, while the other gathered frost. Connect your Hilsch tube to an air line having between 75 and 100 lb. pressure. With the throttle wide open, both arms will be at the same temperature. Close the throttle about half way, and the cold arm reaches its lowest temperature. Close it almost entirely, and the hot arm reaches its highest temperature.

What makes it work? Physicists can agree on an answer, even though the inventor, Dr. Rudolph Hilsch, of Erlangen, Germany, has published his own explanation. But some practical applications have been suggested. C. W. Hansell, RCA engineer, thinks it might cool the cabins of supersonic planes, combating the tremendous heat generated by skin friction at high speeds. Since the inlet could be located on a leading wing edge, pressure, and therefore





**Milling on a Lathe.** Precision boring and milling can be performed on virtually any small machine lathe with a new adapter being manufactured by the Qualified Gage Company, of Berkley, Mich. Providing for both horizontal and vertical movement of the work, the adapter consists of two main parts.



One is a 90-deg. elbow mounted on the cross slide in place of the compound, the latter being attached to the end of the elbow in a vertical position. A faceplate, the second part of the adapter, goes on the compound to hold the work. Adapters are available for virtually all popular lathes.



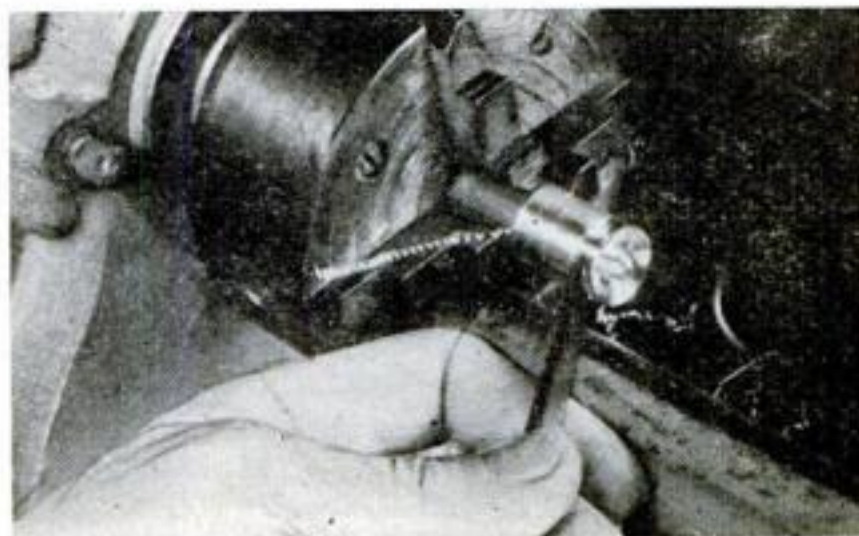
**Blowtorch.** Dry chemical fuel in tablet form is used in a small blowtorch made by the Birk Manufacturing Company, of East Hartford, Conn. Operated by blowing through a flexible plastic tube, the torch is said to be suitable for soft or silver soldering, light brazing, annealing, or hardening of small work. Tests indicate the torch produces temperatures above 2,000 deg. F.

### Collet Chuck.

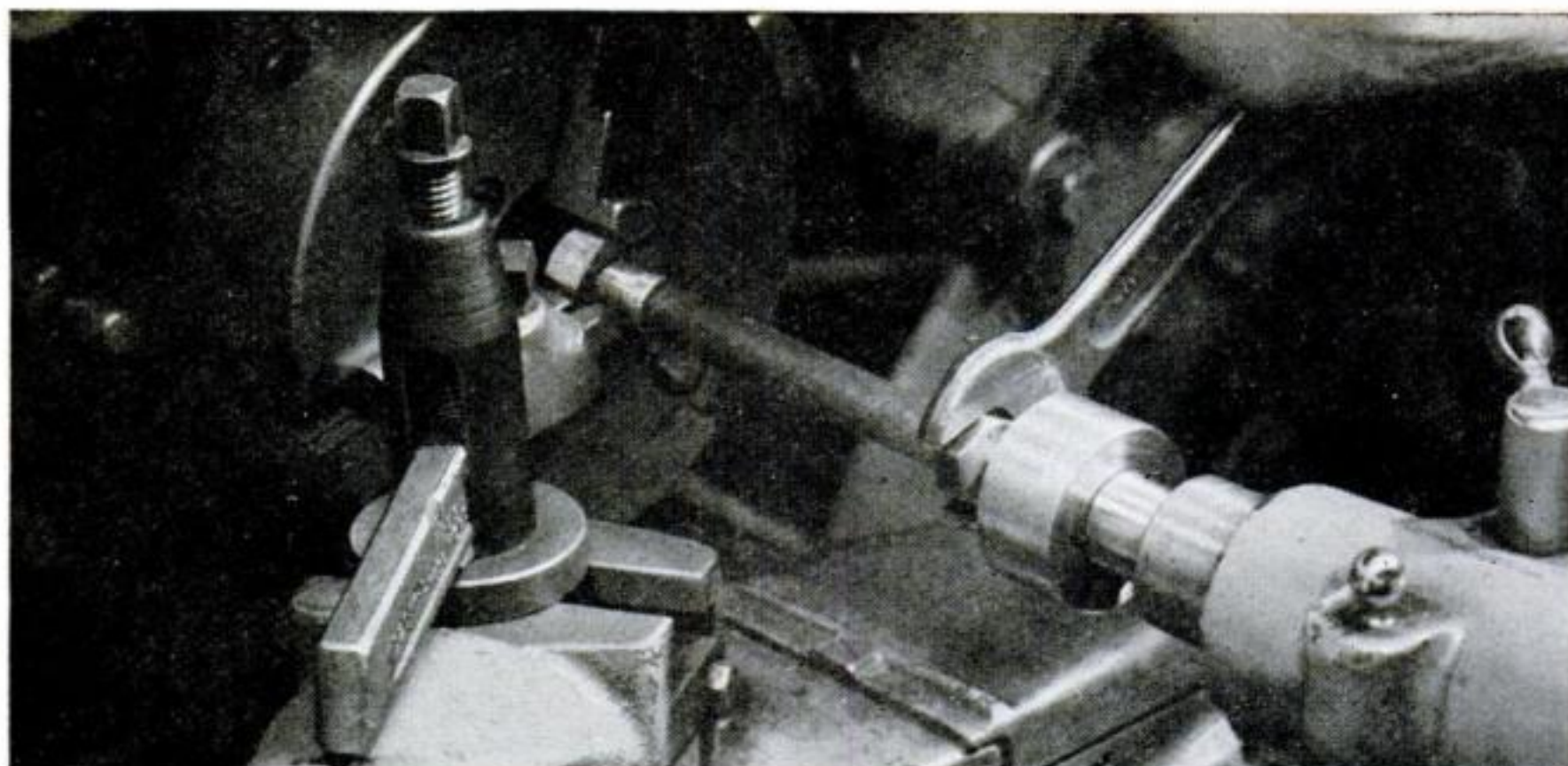
Small drills may be accurately centered with an adjustable collet chuck made by the Chicago-Latrobe Twist Drill Works, the adjustments being made with three screws. It is available with collets of two sizes—the smaller for diameters of .005" to .025" and the other for diameters of .020" to .040". The chuck is priced at about \$20, the collets at \$6 each.



**Metal Turned Freehand.** Lathe chisels with tungsten carbide tips now on the market make it possible to turn soft metals freehand on a wood lathe. They can also be used, of course, for turning plastics and wood. Martin, Inc., of Milwaukee, Wis., offers square and roundnose chisels of this type in  $\frac{3}{8}$ " and  $\frac{1}{4}$ " sizes. The Johns Manufacturing Corp., of Dunellen, N. J., makes them in four sizes— $\frac{3}{8}$ ",  $\frac{1}{4}$ ",  $\frac{3}{16}$ ", and  $\frac{1}{2}$ ". The tips seldom require honing.







**Bolt Threads Extended.** When the threads on a bolt are not long enough, you can extend them with the lathe setup shown. Any lathe with a slide rest will do; no screw-cutting gears are needed.

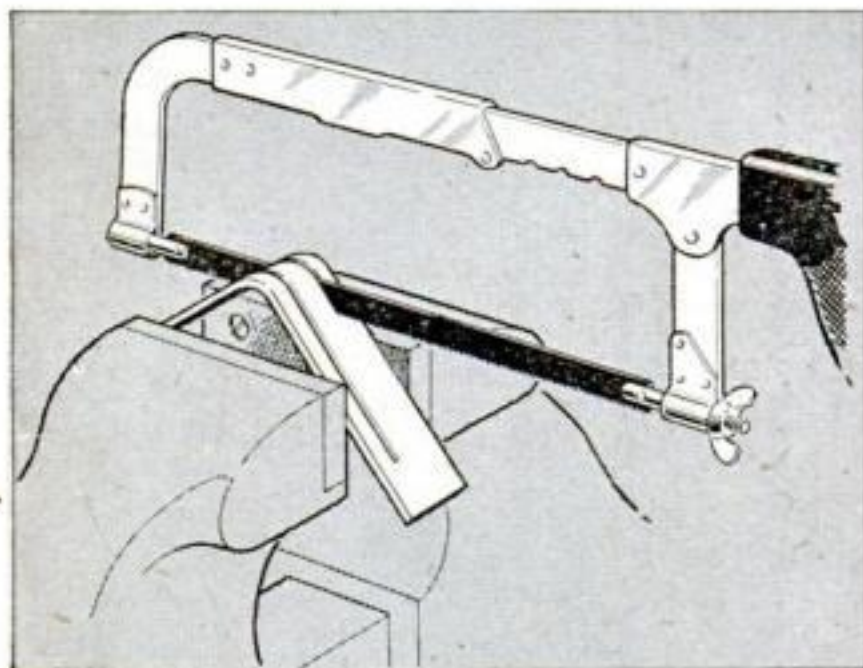
Centerdrill the bolthead and clamp a nut that fits the bolt in the three-jaw chuck. Lock the spindle with the head-stock indexing pin, the back gears, or otherwise. Turn the bolt into the nut and run the tailstock

center up so as to support the bolthead.

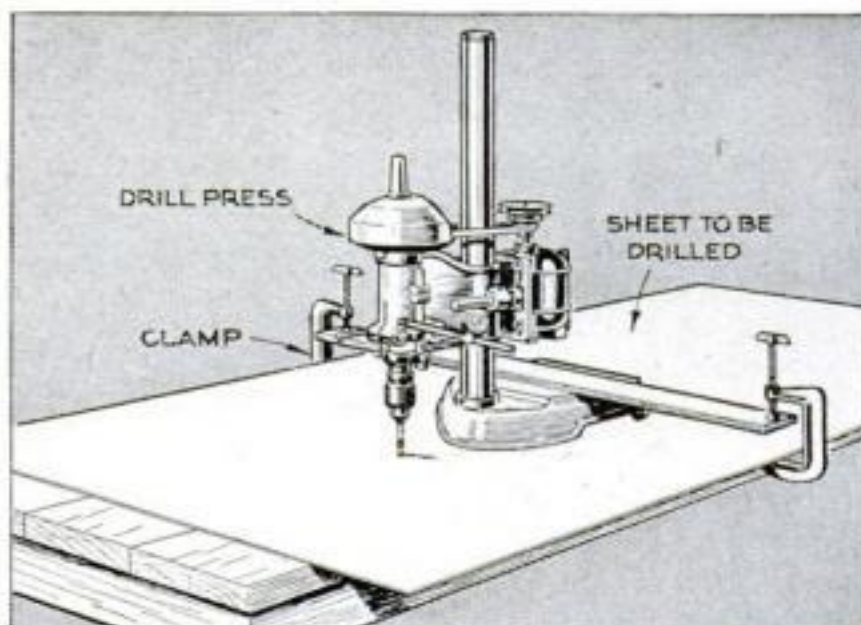
Mount a turning bit with a 60-deg. point upside down in the tool post as above, its point slightly below center height, and turn the slide rest to bring it firmly into a full thread on the bolt. Then turn the bolt slowly into the nut with a wrench, constantly advancing the tailstock center to support the head. If the bolt is tough or has a very coarse thread, make several light cuts.



## NEW SHOP IDEAS



**Cutting a Blind Slot.** Where no great precision is called for and the work will tolerate bending, slots can be cut much faster with a hacksaw than by drilling and filing. Simply bend the piece as above. To remove the waste strip, use a chisel or drill a hole at each end.—H. SCHMIDBAUER.



**Press Capacity Multiplied.** Having to drill numerous holes in a large steel plate, at points far beyond the capacity of my drill press to reach, I made use of the arrangement shown above. The sheet was laid on a sturdy bench and the drill press clamped on top of it by a heavy batten that reached over the edges. Then the head of the press was turned 180 deg. and tightened low down on the column. Of course the machine had to be reclamped for each hole. Although the drawing shows the regular table removed from the column, this may not always be necessary.—R. L. MACLEAN.



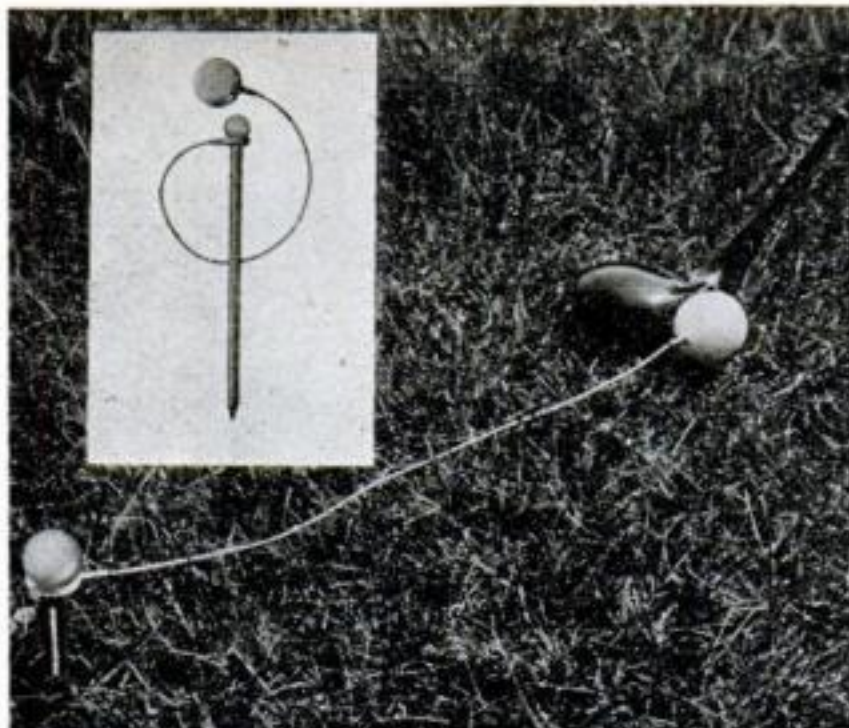




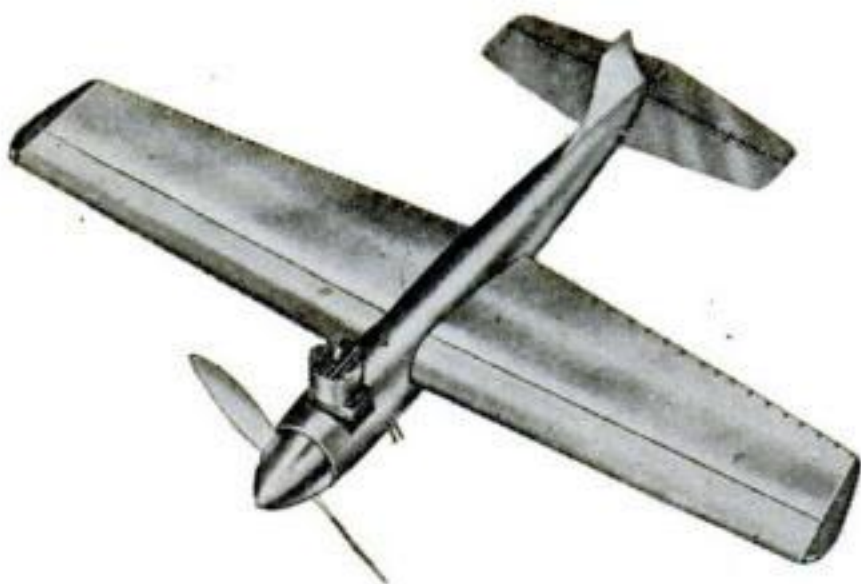
## HOBBY SHOPPING



**Lure Holds Live Bait.** Imagine the surprise of a fish that comes to this lure. The minnow is alive, but is protected inside a transparent plastic casing that magnifies it to appetizing proportions. Made by the Rice Engineering Co., Detroit, Mich., the lure has two triple hooks and a removable head to permit insertion of the bait.



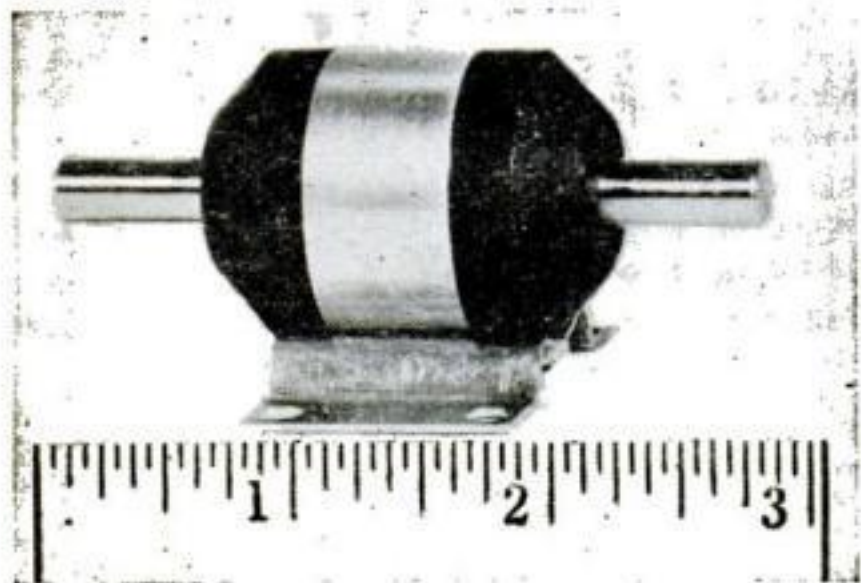
**You Needn't Yell "Fore".** Firmly tethered to a stake driven into the ground, this golf ball never gets away. You just step up, smack it, and let it swing—but better keep out of the way. Manufactured by the Prac-Tee Company, Dayton, Ohio, the outfit is designed for backyard practice. It retails for around \$3.50.



**Plane Made of Magnesium.** Built of magnesium, this model plane has the lightness of wood with far greater strength. It is furnished in kit form by Rokwell Industries, Inc., of Clayton, Mo. Wing, fuselage, and control surface sections are preformed.

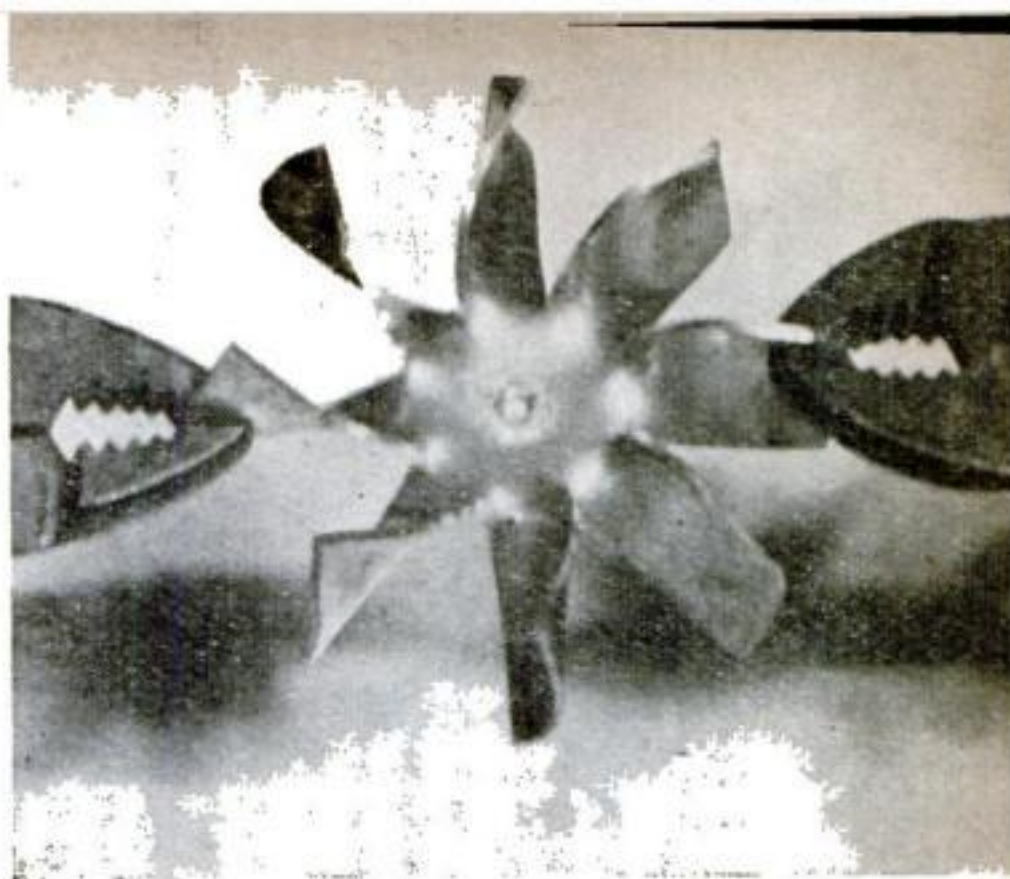
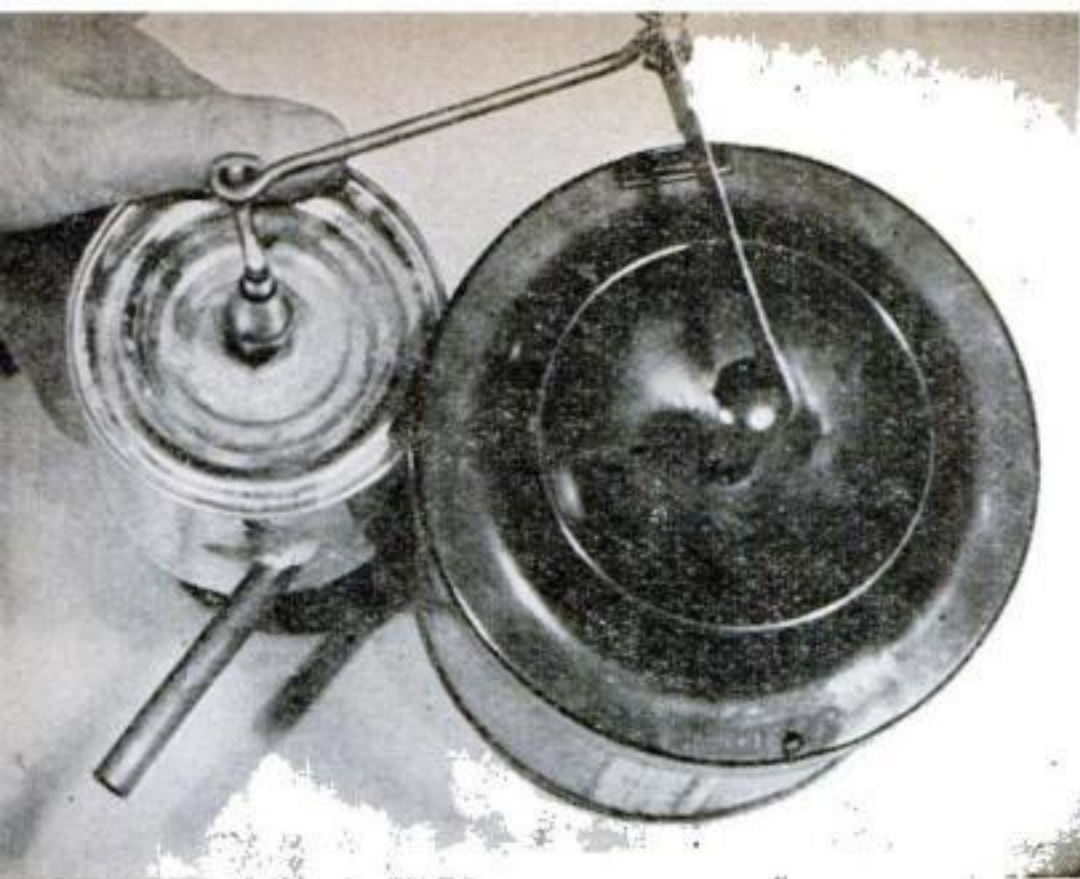


**Carbon Dioxide Runs Engine.** Standard carbon dioxide cartridges power a model airplane engine produced by the Herkimer Tool and Model Works, Inc., of New York. Weighing less than  $\frac{1}{4}$  oz., the engine has a finned steel cylinder, can be adjusted to run up to 60 sec. on a charge, and swings a 7" propeller with ease. It's suitable for model planes up to 140 sq. in. wing area. The engine sells for about \$7.50.



**Speed Changer Aids Hobbyists.** Designed to increase or decrease shaft speeds in small power devices, this miniature gear box is available in various gear ratios. Built by the Metron Instrument Company, Denver, Colo., it has concentric drive shafts mounted in ball bearings. Power passes from the input shaft through spur gears to a countershaft, thence through another set of gears to the output shaft. Intermediate gears run in graphitic plastic bearings. The price runs from \$16 to \$18.50, depending on the ratio.





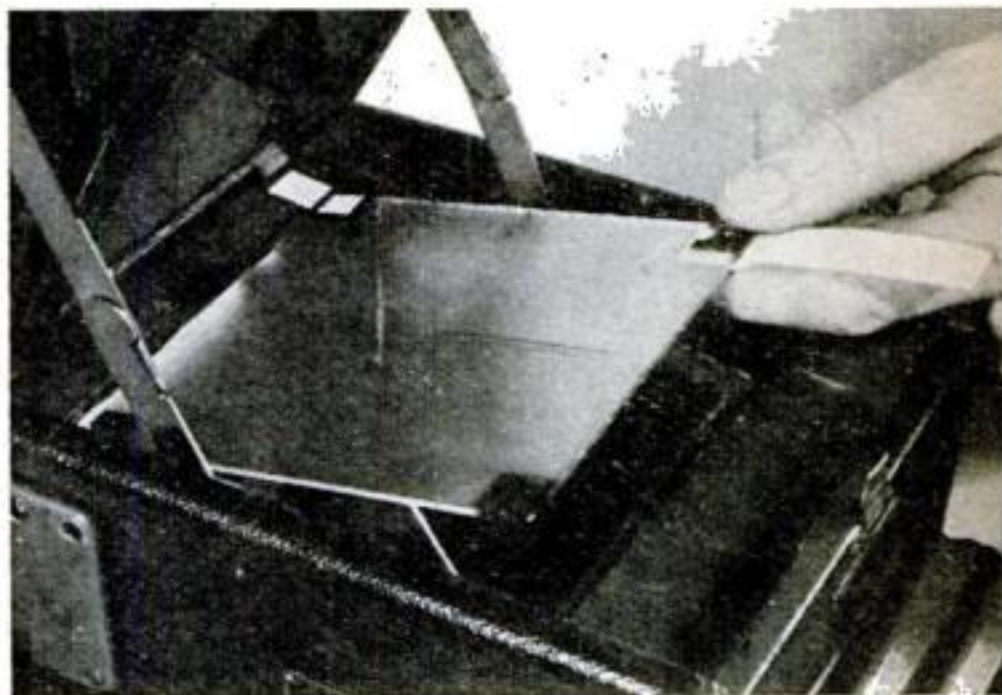
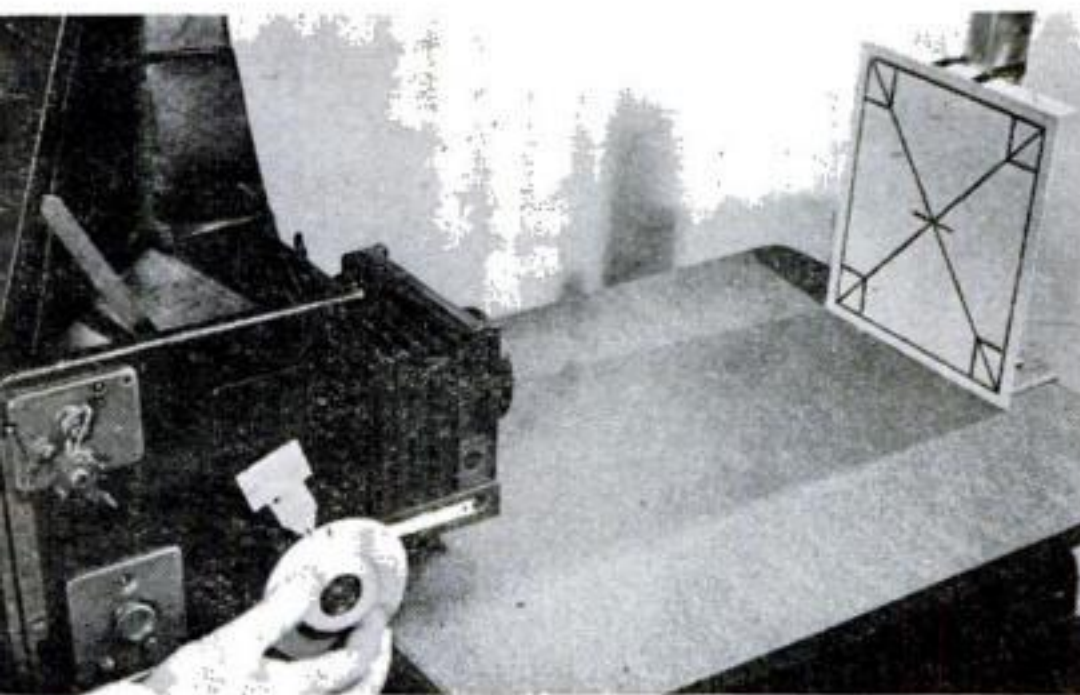
## Water Power Agitates Roll-Film Developing Tank

WITH this water-driven agitator, you can avoid the tedious job of agitating a roll-film tank by hand. A revolving crank on the water wheel moves a metal arm, bolted to the tank knob, back and forth through an arc by a pivoted linkage.

Solder a can upside down against the side of another large enough to hold the tank. Punch a center hole in the bottom of the first and solder in a short piece of copper tubing as a bearing. For the water nozzle,

solder another piece of tubing at a tangent into the side. Make the rotor from a disk of thin brass or copper as at right above.

Brazing rod may be used for the shaft and linkage. After bending a crank, thrust the shaft through the bearing, and solder on the rotor. Slot one end of the knob arm and curl and solder the fork so formed around a brass pin on which the linkage pivots. File a flat on one side of the knob to make it easier to bolt the arm fast.



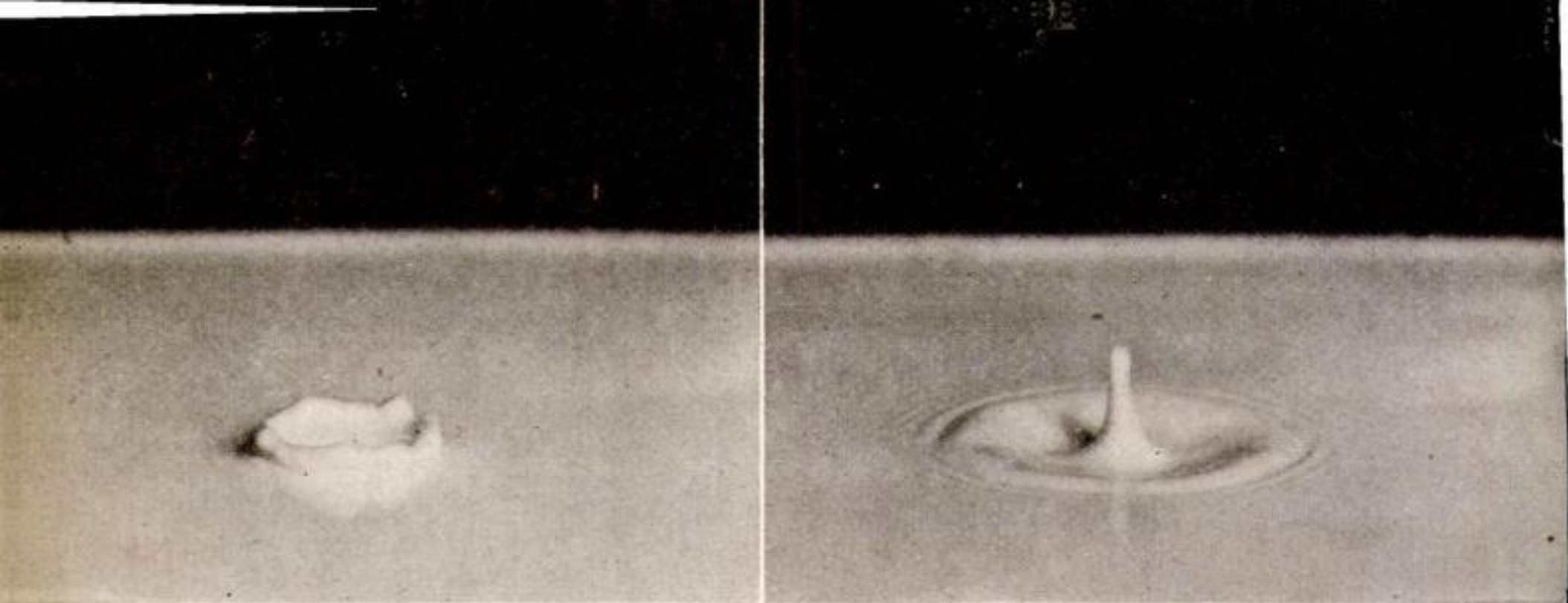
## Reflex Focusing Screen Checked by Simple Method

WHETHER the focusing screen of a single-lens reflex camera is accurate may be checked by placing the camera about 36" from an ink-lined cardboard sheet, stopping the lens down to  $f/8$ , and installing a back focusing screen in the exact film plane.

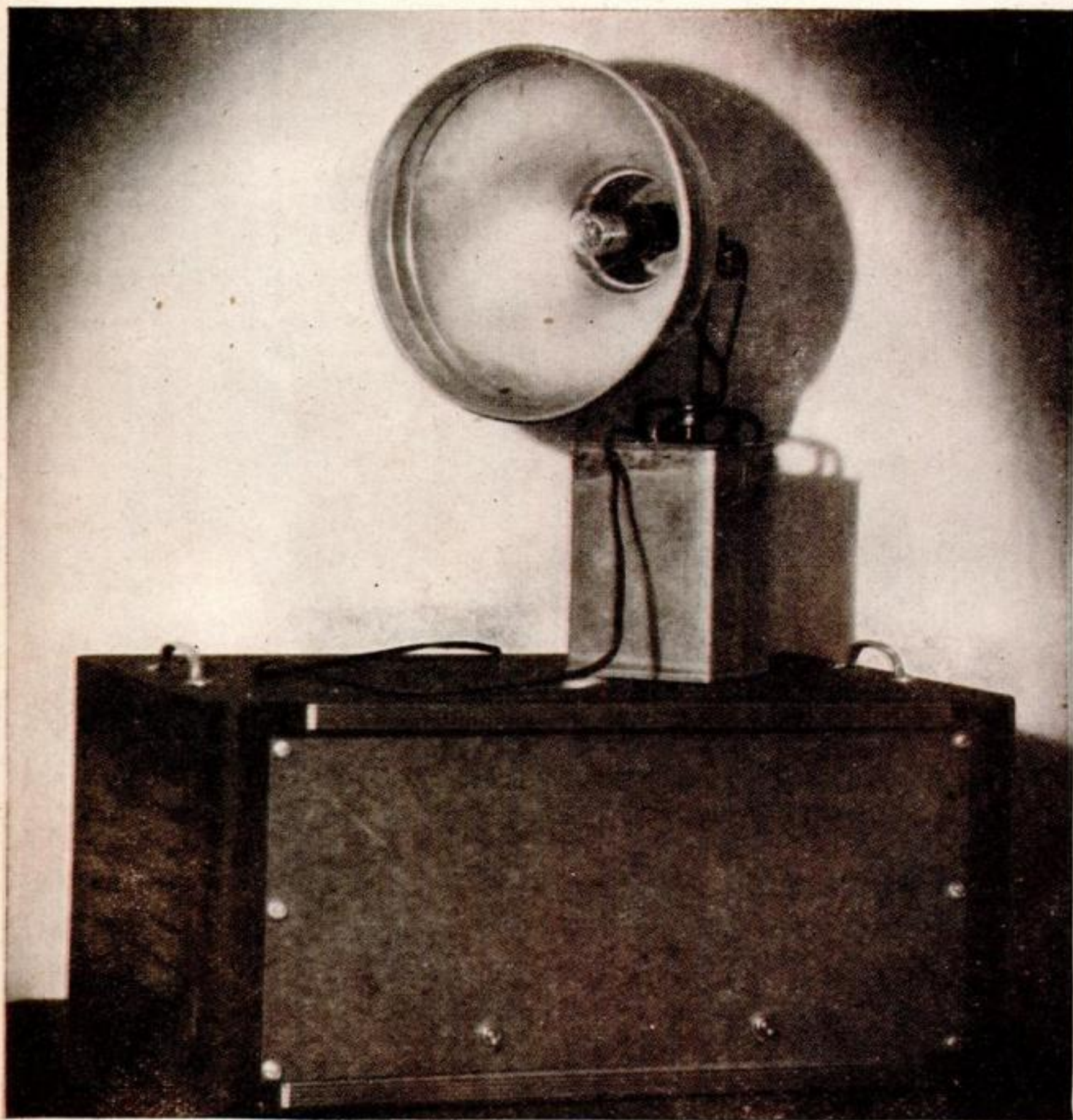
The screen may be ground glass in a film-pack adapter, or, in a roll-film camera, it may be taped in place. Also attach a cardboard dial firmly to the focusing knob and a cardboard pointer to the camera.

After focusing the image sharply on the back screen, turn the knob until the lines begin to blur and mark the dial at the pointer. Then move the lens back through the sharp area until the lines again blur and mark this point also. Focus the top screen the same way. If the latter is accurate, the sets of marks will coincide. If they do not, check the action of the mirror. The screen can be raised, if necessary, with tape under the corners (right above).—H. R. HEYDORF.



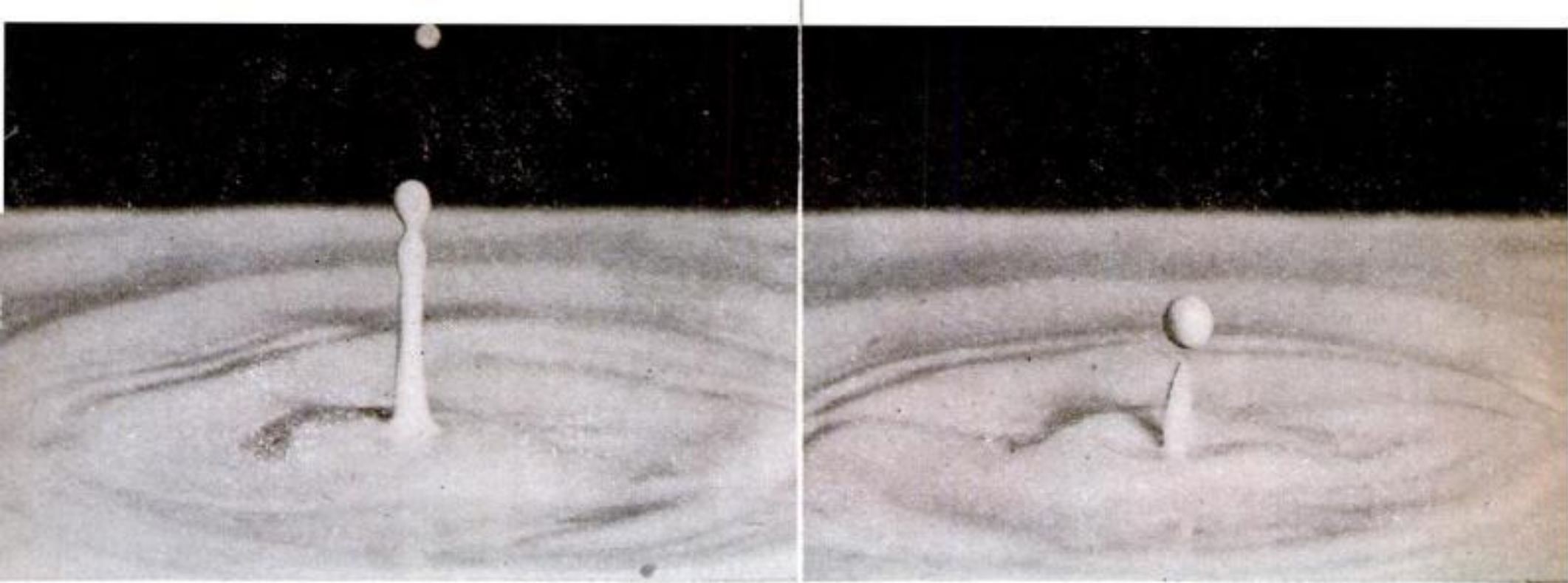


Falling into a pan of milk, a drop of milk forms a crater. Then a column begins to rise . . .



Fully assembled, the unit is compact and quite easy to move from place to place. An ordinary radio cabinet is used to house the parts. The two control switches may be seen on the front.





A droplet breaks away and goes higher. Falling, the drop causes the same cycle to repeat.

# Homemade Speed Flash Makes Time Stand Still

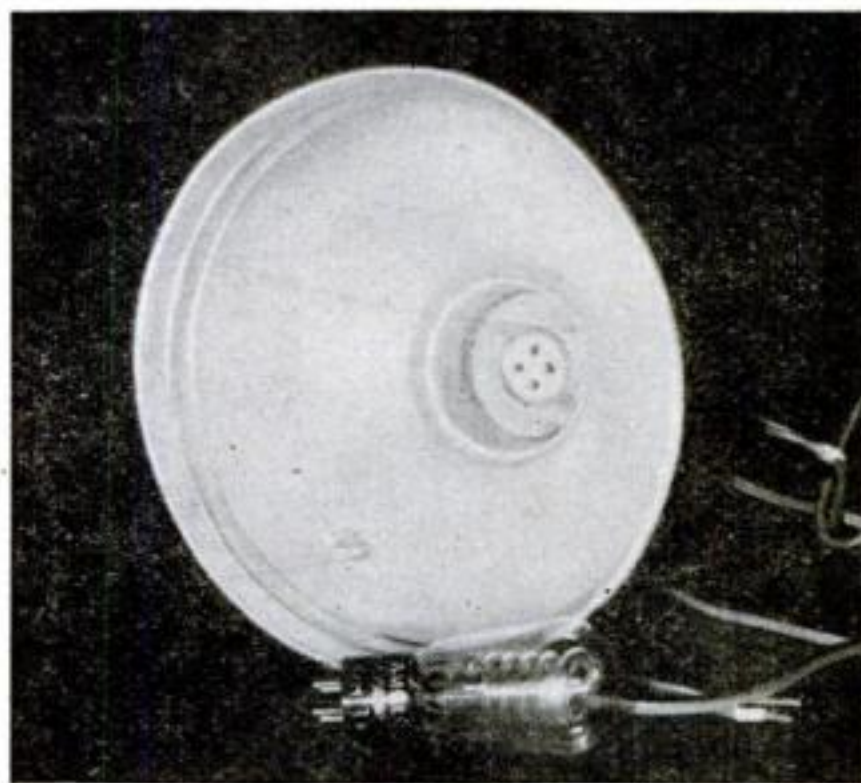
By Michael S. Spacek, Jr.

**H**OW often have you sighed over those fast-action shots that weren't quite fast enough? How many times have ordinary synchronized flash and a shutter speed of 1/500 proved sluggish when the negative was developed? Well, you can capture the briefest part of a movement and get fine, clear detail of people or objects no matter how rapidly they may be shifting. Your top shutter speed won't matter, either, because you'll be using bulb exposure for the most part.

The trick, of course, is to control the light source. Here's a device that really cuts it fine—down to 1/10,000 of a second! That will stop a lot of action the human eye can't even begin to follow. Take the pictures above, for example. They show four stages in the life of a milk drop. No matter how many times you may have seen it in real life, it's a safe bet it never looked like that before. These shots were taken by the open-flash method in which the camera is set on time, the light is fired, and the shutter is closed.

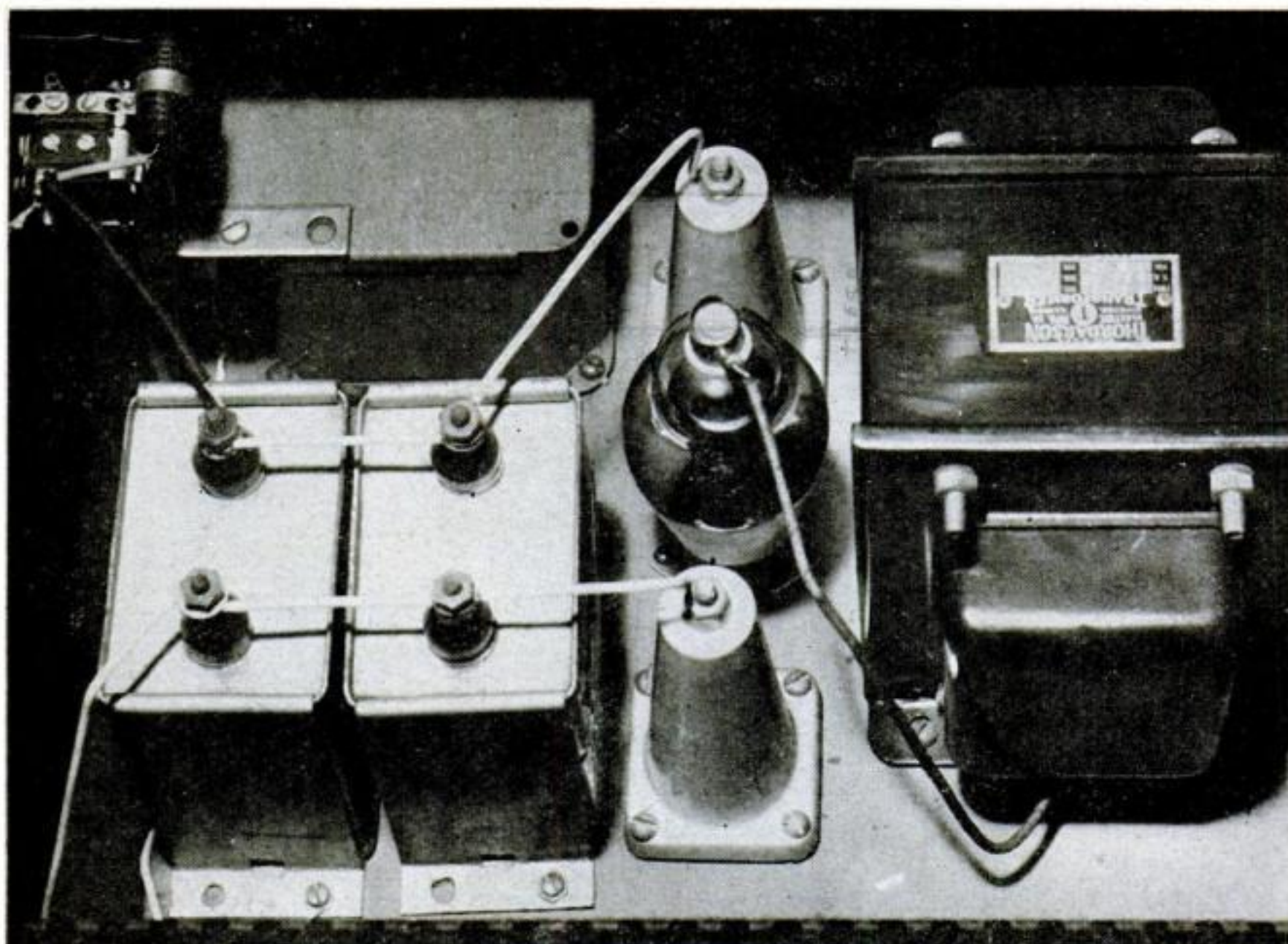
What that means, among other things, is that even after you have built your high-speed flash equipment you won't be able to sit back and let the machinery do the work. Photographic skill will still be the main in-

gredient of good pictures. Obviously speed isn't called for if you are shooting still lifes, but if you want to record the instant that a dropped glass shatters or find out what the impact of a bat on a baseball is like, you'll have to trigger the shutter and light relay at just the right instant. Some shots are bound to be wasted, but with practice the number will get smaller. The sequence above, for example, was selected from 10 neg-



Mount the tube in a photo reflector. Install a four-prong radio socket to take the flash tube.





Heavy-gauge wire and stand-off insulators keep leads from touching or shorting to chassis.

atives. Each of them happened to show a distinctly different stage in the process.

While the particular unit shown here was designed chiefly for open-flash work, it can be synchronized with a camera shutter by substituting a low-voltage relay connected to any standard synchronizer. Switch S2 will then have to be a single-throw type in the transformer circuit only. This switch should be opened before the light is fired to avoid burning the relay points. After making the connection, adjust the synchronizer so that the light flashes during the time the shutter is open. With synchronization it will be possible to take pictures even in subdued outdoor light. Experiment with various combinations of fast shutter, small lens stop, and slow film until you find one in which the film is barely exposed by the ambient light. The instant of the high-intensity flash will then provide practically the only exposure for the negative.

High-speed flash equipment is simple enough in principle. A transformer steps up your 115-volt AC to about 1,800 volts, and this voltage is then rectified and stored in a bank of condensers. At the proper instant the charge is effectively short-circuited

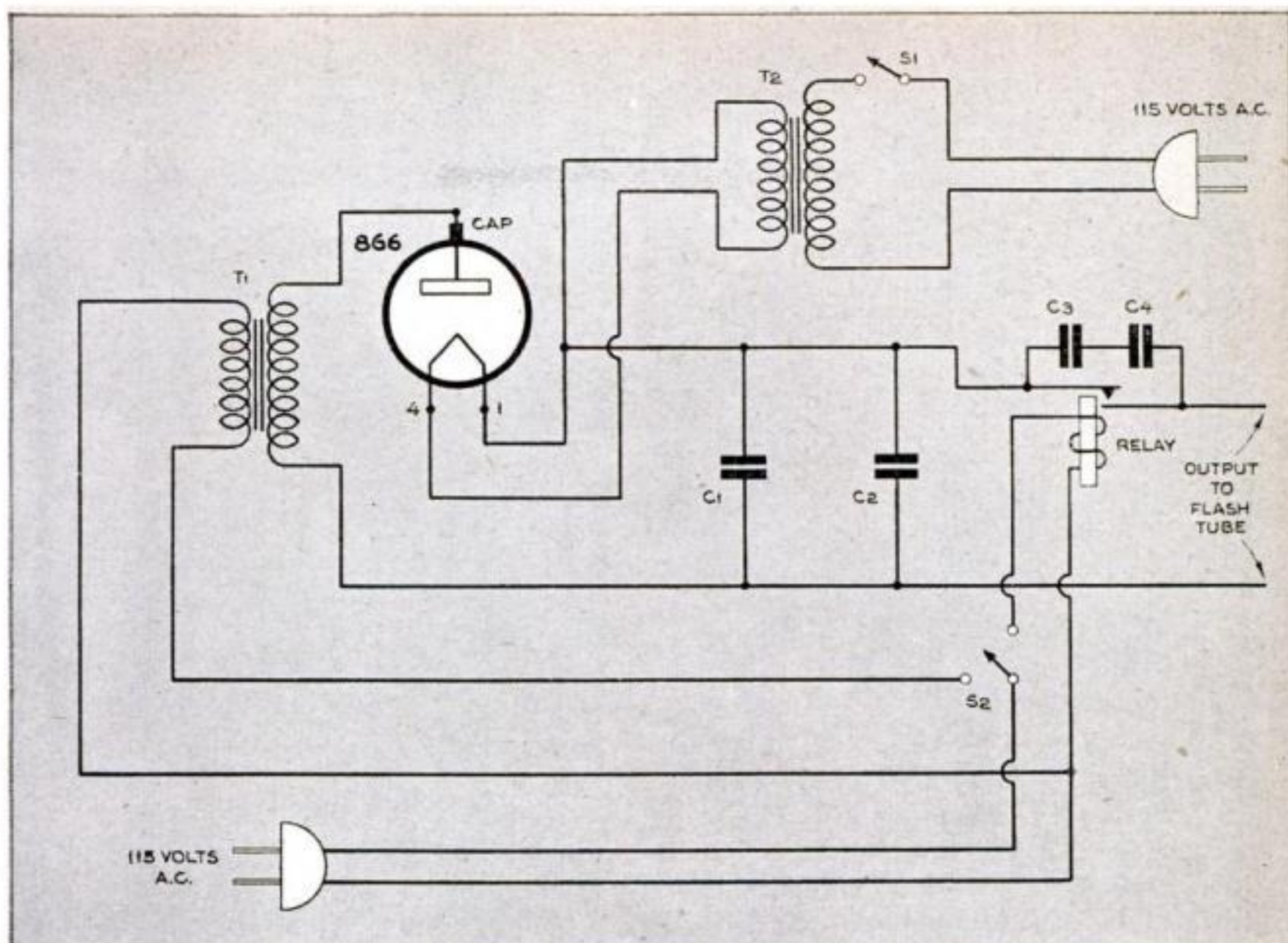
through a low-resistance load represented by the flash tube. The tube lights up brilliantly for the tiny fraction of a second it takes the stored charge to break down below the strike voltage needed to activate the tube.

The flash tube has a rated output 100 times that of sunlight, so that it is good for color as well as black-and-white. It should last for thousands of flashes—which, incidentally, makes this an economical flash outfit even for straight shots you'd ordinarily make with flash bulbs.

Parts are mounted on an 11" by 16" radio chassis with machine screws, and connections are made with heavy-gauge wire. All wire is insulated, and the high-voltage leads separated from the chassis by stand-off insulators. The entire unit is encased in a metal box.

For the circuit-closing device, a heavy-duty, 115-volt SPST relay is used. To protect the relay points, two .01-mfd. condensers (C3, C4) are shunted across them. The relay side of the output line is the plus or positive side, and should be connected to the plus side of the flash tube as specified by the manufacturer.





The relay is in the positive output lead; this side goes to the plus end of the flash tube.

### LIST OF PARTS

C1, C2: 10-mfd., 2,000-volt filter condensers.  
 C3, C4: .01 mfd. 1,600 volts.  
 T1: high-voltage trans., 1,800 volts, 50 ma.  
 T2: filament trans., 2.5 volts, 10 amp.  
 S1: SPST toggle.

S2: SPDT toggle or microswitch.  
 Relay: normally off, SPST, 115 volts, heavy duty.  
 Type 866 rectifier tube, two 4-prong ceramic tube sockets, Amglo series 51 photoflash tube, 12" photo reflector, 11" by 16" chassis, two stand-off insulators.

Note that two separate plugs are indicated in the diagram; this simplifies switching and makes it harder to mistake the sequence of operation. It's always a good idea to let the filaments of a high-voltage rectifier warm up before turning on the plate juice. In using the flash outfit you do this by first connecting the filament line and closing switch S1. Wait a minute or so and then insert the high-voltage plug into an outlet. Switch S2 should be in the lower position to feed the transformer primary. In about five or ten seconds, the condenser bank will reach full charge, after which you can fire away by flipping S2 into its second position. This first opens the high-voltage circuit and in virtually the same motion energizes the relay and puts the voltage directly across the flash tube.

A word of caution: the condensers store

a voltage in the neighborhood of 2,000. As this voltage strikes across the low breakdown resistance of the tube, enough current flows to end forever your interest in photography. The two things to remember, then, are that all your wiring, and particularly that part in the output circuit, must have sturdy, high-voltage insulation. Also, you must not, under any circumstances, tinker with a live circuit. Before touching any part of the wiring, be sure that both plugs are pulled and that you have discharged the condensers by shorting their terminals with a well-insulated screwdriver.

Correct exposure can be determined by a few trial shots. If the recommended values are used in building the unit, for film with a Weston rating of 50, f/11 should be about right with the camera and flash 6' from the subject.

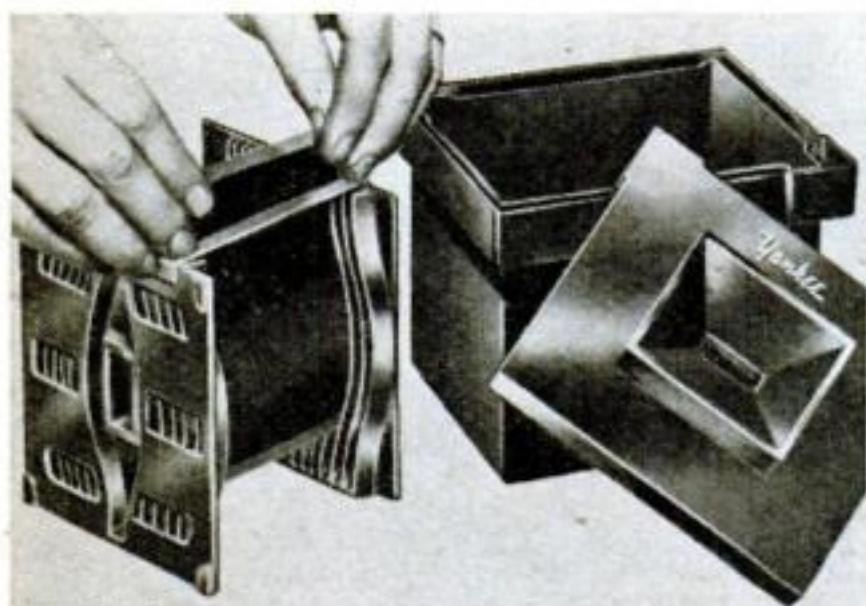
END





## PHOTO IDEAS AND EQUIPMENT

**Diffusers Snap On.** Made of a non-woven, plasticlike material, this diffuser has a strong elastic edge that permits it to be quickly snapped on or off the reflector. When not in use, it can be crumpled into small space and stuffed into the pocket or camera case. Manufactured by Martin Products Co., Brooklyn, N. Y., in sizes to suit all reflectors, the diffusers range in price from 25 cents to \$1, depending on the size.



**Tank Easily Agitated.** An adjustable cut-film and film-pack developing tank, suitable for any size from 2¼" by 3¼" to 4" by 5", is produced by Windman Brothers, of Los Angeles. Four buttons on the bottom permit agitation by gentle rocking, and curved loading grooves keep the films under tension, preventing them from touching.

202 POPULAR SCIENCE



**Dry Your Drying Alcohol.** When alcohol is used for rapid drying of negatives, it eventually absorbs so much water that it is no longer effective. Its usefulness can be restored by immersing in it a little potassium carbonate (anhydrous) tied in a clean cloth. Because this chemical has such an affinity for water, it will remove the water from the alcohol. The chemical may be dried and used again.—R. F. DONAVAN.



**Paper Has Its Own Border.** Contact paper offered by Devolite-Peerless, of New York, has a preprinted mask that leaves an even white border when the paper is processed. If examined before processing, a piece of the paper is seen to have a greenish-yellow line all around. This disappears in the hypo, leaving a glossy white border.

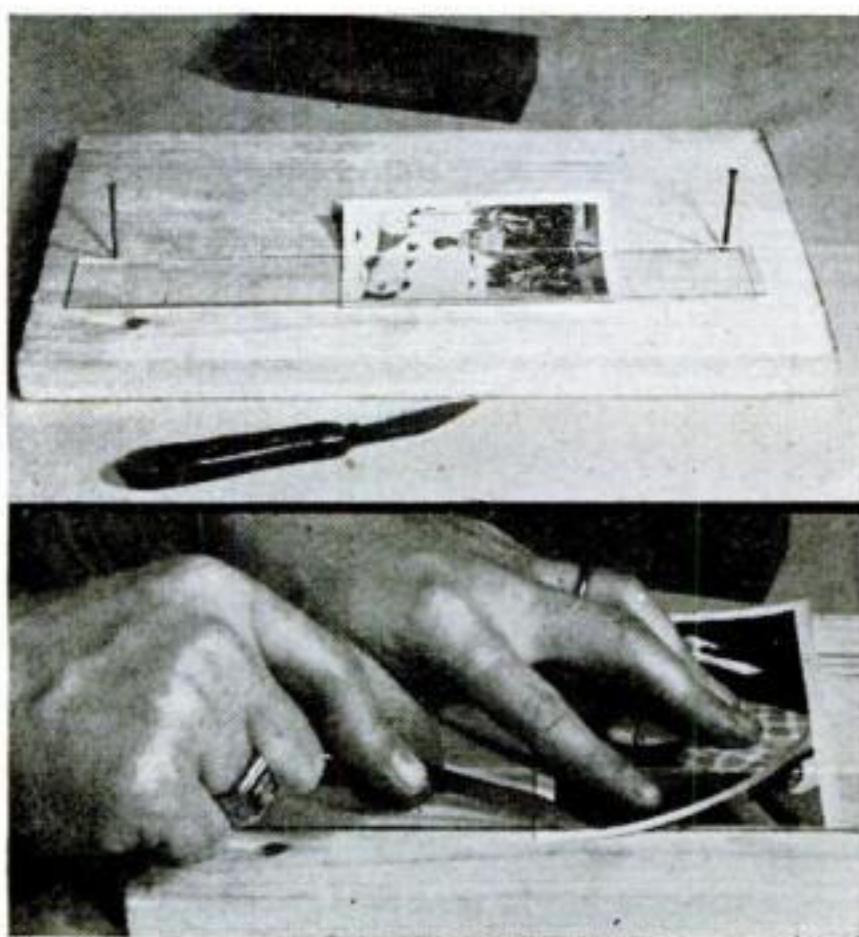




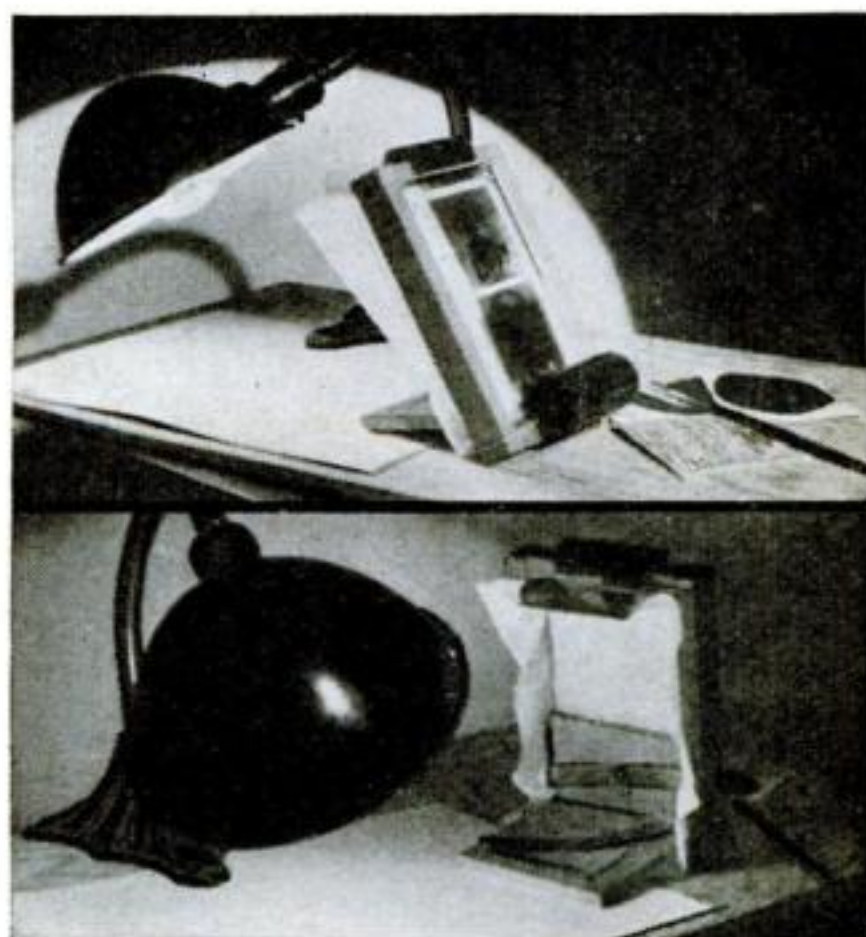
**Attachments for Copying.** Originated in Scotland, these new Stewartry copying attachments are distributed in the United States by Caprod, Ltd., of New York. Designed for use with Leica, Contax, and cameras of similar type, the attachments include a clamping arm, a focusing screen,



and various extension tubes for work at close range. At the left, a Contax lens and the focusing screen are mounted on the arm. After focusing, the screen is removed and the camera mounted in its place, the film lying in the same plane as the screen. Three extension tubes are seen in the foreground.



**Glass Gives Even Borders.** A glass straightedge provides a handy way of cutting even borders on a print. Shape the straightedge with a glass cutter, smooth the edges with an oil stone, and space two brads on a smooth board so the glass may be positioned against them. The glass makes it possible to see that the print is in the proper position for an even border.—L. K. LOOMIS.

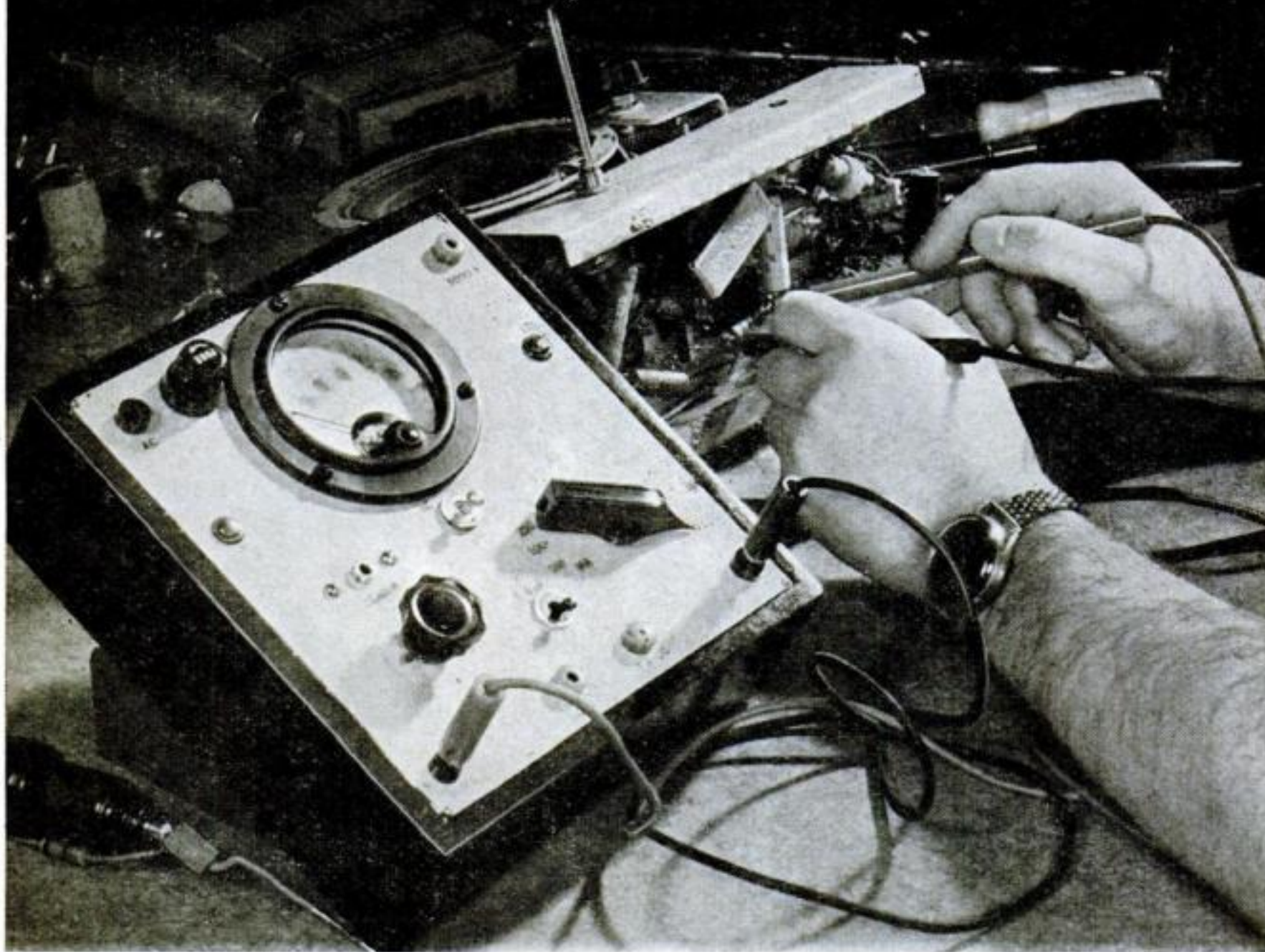


**Easel Made from Frame.** A re-touching or spotting easel may be improvised from an ordinary printing frame. As seen in the lower photo, the hinged back is clamped in place at the bottom of the frame, allowing one portion to act as a support. Tissue paper between the glass and frame gives even illumination. Rubber bands will hold uncut roll film in place.—E. J. LURZ.



# Building a Multimeter

PART 2



The multitester above, diagrammed on page 206, is a wide-range, general-purpose unit.

**By Gilbert Sonbergh**

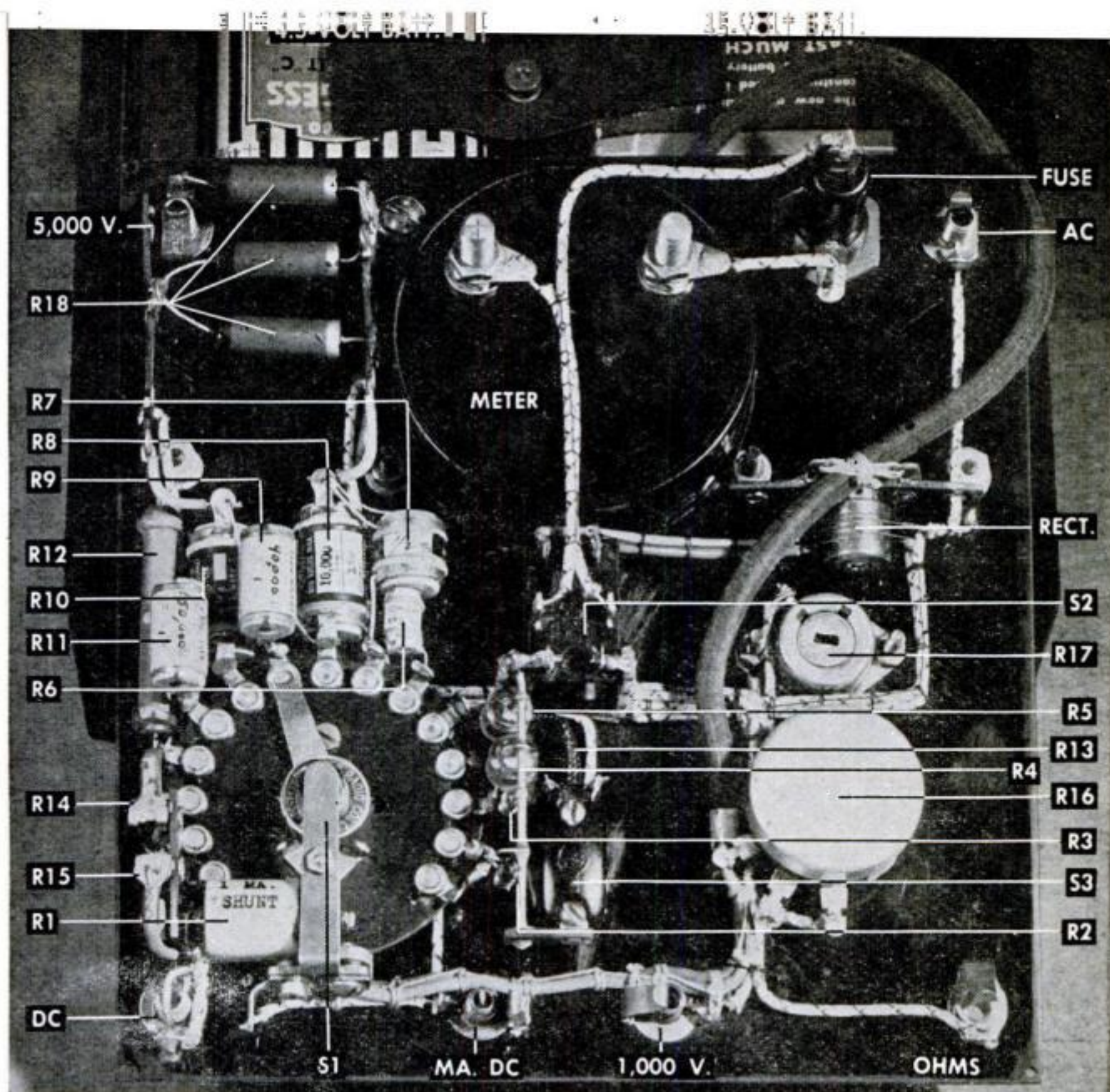
**B**EFORE you start to build your own multitester, look over the fundamental data on the relationship between volts, ohms, and amperes given in the previous installment. With this information you can design a meter for any special purpose, adapt spare parts to suit your circuit, or build a general-utility multimeter for radio and electrical checking. To make use of spare parts, you must design your circuit around them, for you can't substitute values that are nearly but not quite correct. Resistors must be calculated with great precision. Wherever possible, use wire-wound resistors that are guaranteed accurate to 1 percent. Carbon resistors, costing much less than the wire-wound type, may be used in some cases, although they are less likely to be stable over a long period of time. They do, however, have one advantage in that

they can be adjusted upward in resistance value. To do this, file a small flat on one side. Check the resistor on an accurate ohmmeter as you file it, and when you have exactly the right value, coat the scored part with wax or varnish to keep out moisture.

The photographs and the diagram on page 206 show a V-O-M meter designed to get the most measuring power in a relatively simple one-meter unit at moderate cost. With the aid of a few calibration graphs, this tester can cover more than 24 ranges of ohms, microfarads, henrys, AC and DC volts and milliamperes.

Suggested diagrams for simpler and less costly meters are given on page 207. Both of these models use standard O-1 ma. meters and simplified switching systems. In the diagram at the left, toggle or pushbutton station-selector switches are employed; note that the 10- and 100-ma., as well as the





All parts except the batteries are mounted on a bakelite panel, shown here from beneath.

ohms-divided-by-ten ranges call for double-pole arrangements. If pushbutton switches are used, depress two buttons simultaneously. The companion drawing calls for only one switch, and this is on R16 so that the 10,000-ohm resistor can be cut out of the circuit for readings other than ohms.

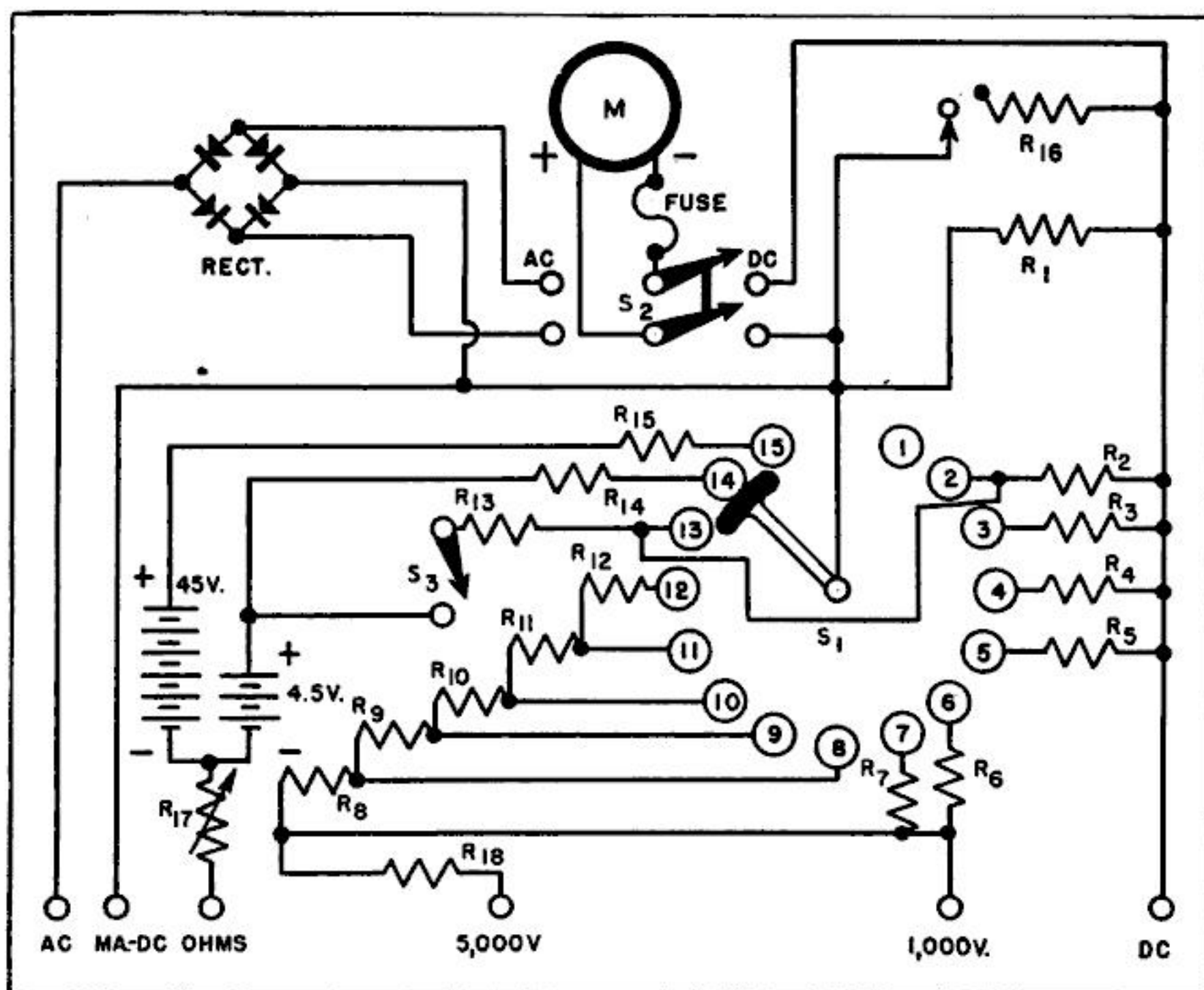
No matter what meter you elect to build, two general precautions should be observed. First, avoid meter overloads, especially in switching. Second, make certain that components are satisfactorily outside the circuit or isolated when the meter is positioned on a range not calling for them. For example, the meter in our principal circuit would be seriously overloaded if you switched from one milliampere range to another while making a measurement except for the fact that the rotor of S1 touches one contact before leaving the previous one.

Despite all precautions, accidents do happen, which is why all circuits display fuses.

The type of fuse to use is one that will "let go" quickly on currents 10 to 25 times greater than the meter's normal full-scale capacity. The resistance of the fuse, however becomes part of the circuit and must be taken into account in all calculations. Make sure you can get replacements of exactly the same resistance. A good procedure is to pick some identical fuses from your dealer's stock with the aid of a low-range ohmmeter.

Our major circuit contains a feature that is well worth considering in the design of your own multimeter: it has equal sensitivity of 1,000-ohms-per-volt on both the AC and DC ranges, making it possible to use the same set of multipliers and main selector switch for both currents. This arrangement cannot be achieved with an ordinary O-1 ma. movement, but calls for a meter that will give full-scale deflection on .89 to .9 ma. for use with the full-wave rectifier connec-





### LIST OF PARTS

M: DC milliammeter with full-scale sensitivity of 0 to .89 ma. and internal resistance of 105 ohms.  
 Fuse: 1/32 amp., tested at exactly 20 ohms.  
 S1: 15-position, meter-type rotary.  
 S2: DPDT toggle (AC-DC).  
 S3: SPST (ohms-divided-by-ten).  
 Rect.: full-wave meter rectifier.  
 R1: 1,011 ohms (1-ma. DC shunt).  
 R2: 12.36 ohms, wire (10-ma. shunt).  
 R3: 2.27 ohms, wire (50-ma. shunt).  
 R4: 1.124 ohms, wire (100-ma. shunt).  
 R5: 0.447 ohms, wire (250-ma. shunt).  
 R6: 890 ohms (1-volt multiplier).  
 R7: 4,900 ohms (5-volt multiplier).

R8: 9,900 ohms (10-volt multiplier).  
 R9: 40,000 ohms (for 50-volt range with R8).  
 R10: 50,000 ohms (for 100-volt range with R8-9).  
 R11: 150,000 ohms (for 250-volt range with R8-10).  
 R12: .75 meg. (for 1,000-volt range with R8-11).  
 R13: 439 ohms (450 ohms center scale).  
 R14: 4,400 ohms (4,500 ohms center scale).  
 R15: 45,000 ohms (45,000 ohms center scale).  
 R16: 10,000-ohm wire-wound rheostat with "off" or open position (series ohmmeter zero adjustment).  
 R17: 500-ohm wire-wound rheostat (shunt ohmmeter zero adjustment).  
 R18: 1-watt carbon resistors in series, totaling 4 meg. (5,000-volt multiplier with R8-12).

tion shown. Most meter manufacturers either stock meters of this description or will supply them on special order. For DC ranges, sensitivity is reduced to 1 ma. by means of shunt R1.

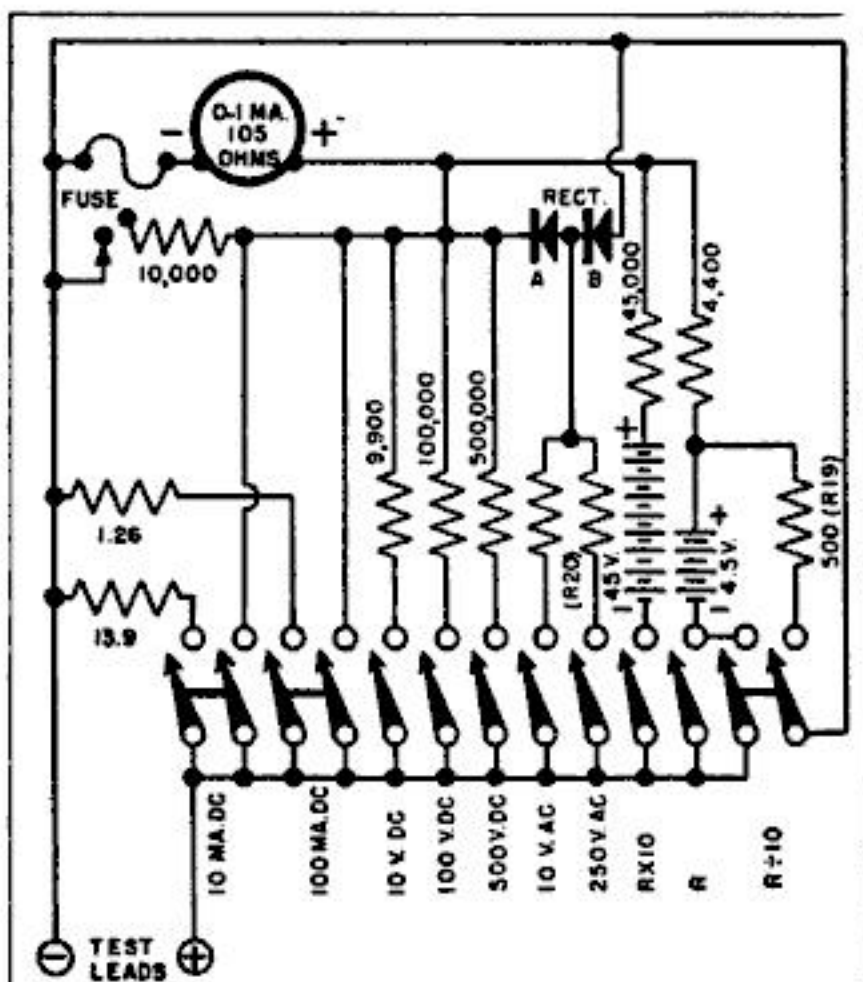
Alternating currents and voltages are rather elusive things to peg since their actual values are constantly changing. That quantity of AC that we mean when we say one ampere actually hits a *peak value* of 1.41 amp. both sides of zero. We call it one ampere because it has the same heating effect as that amount of DC. In other words, 1 amp. is its *effective value*, also known as *root-mean-square*, or *r.m.s.*

But that's not all. If an AC current of

1.41 ma. peak value is rectified and sent one way through a DC meter, we get a deflection of only .9 ma. This is the *average value* of the pulsating current. Hence, in order to get our meter to read full scale with 1 ma. of *r.m.s.* AC going through the rectifier, we want a meter with DC sensitivity of about .9 ma. Theoretically, .89 ma. will give greater accuracy because rectifiers are not in actual practice strictly unidirectional in their conductivity.

All this applies only to a full-wave rectifier used with a .89 ma. meter as in our main diagram. The other schematics show half-wave rectifiers and 1-ma. movements. To compensate for the difference between

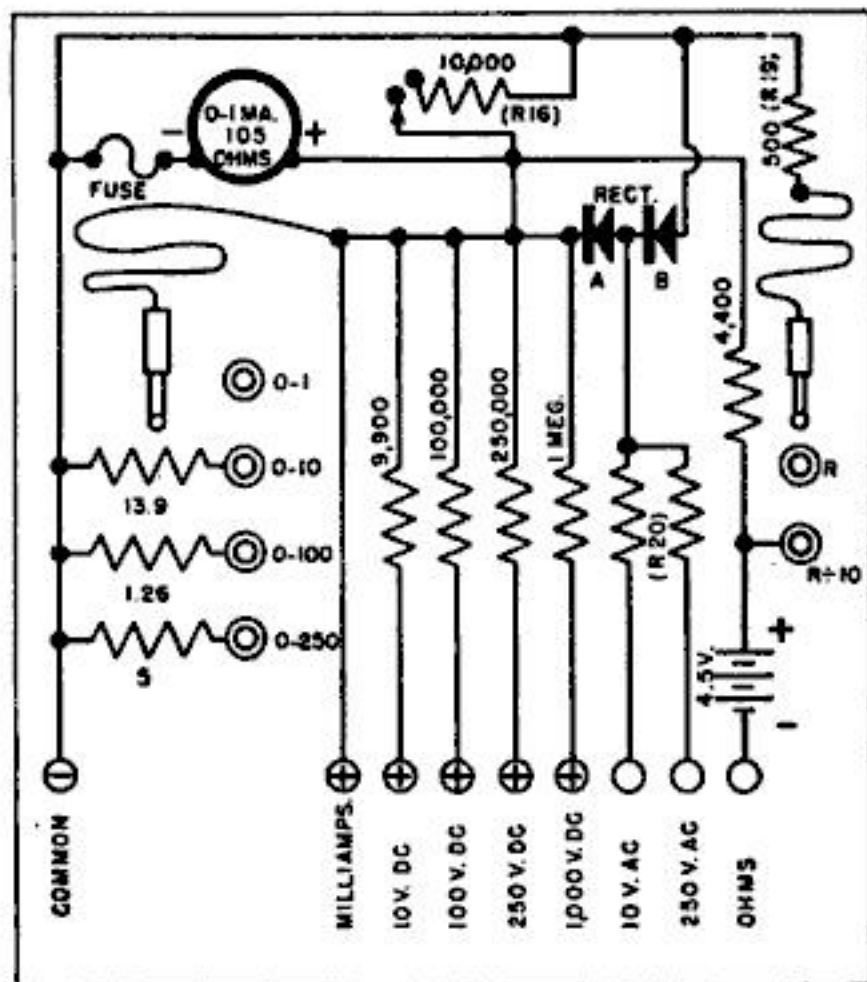




Pushbutton selector switches or individual toggles are used here to simplify switching.

average and r.m.s. values, the AC multipliers (R20 in both circuits shown above) are made smaller than the comparable DC multipliers. Using half-wave rectification, R20 will be approximately 445 ohms-per-volt (4,000 ohms for the 10-volt, and 110,000 ohms for the 250-volt scale). With a four-element full-wave rectifier these values are doubled. As a check on operation, apply known DC voltages across the AC terminals; the indication should be about 11 per cent too high.

As was noted in the previous installment, ohmmeters are usually peaked at center scale, common ranges being 45,000 ohms, 4,500 ohms and 450 ohms. Using a 0-1 ma. meter, the former calls for a 45-volt battery and total series resistance of 45,000 ohms. For the second, both values are divided by ten. To divide again by ten in order to achieve the third range would seemingly call for a .45-volt battery. Since there is no



For portability the high-ohms range has been omitted, doing away with the 45-volt battery.

reliable means for obtaining such a battery voltage, we must use a higher voltage and a higher full-scale current in order to maintain total series resistance of 450 ohms. Two methods of accomplishing this are shown in the diagrams.

In the one on page 206 the meter is shunted to read 10 ma. full scale. Note the jumper from the 10 ma. shunt, R2, to position 13 on selector switch S1. When S3 is closed, a current of 10 ma. flows from the 4.5-volt battery through R13 and the shunted meter. For measurements on the series-ohm ranges, R17 is set at zero and can therefore be disregarded.

The second method for obtaining the lowest series-ohms range requires the addition of just one resistor to the 4,500-ohm center-scale circuit. This is R19 in the two smaller diagrams; the 500-ohm unit shunts the 4,500-ohm resistance that is made up by adding 4,400 ohms to the approximately 100-ohm meter. Two things are accomplished by R19: the reduction of the total circuit resistance from 4,500 to 450 ohms, and the by-passing around the meter of nine-tenths of the resulting increased current.

If still lower ohms ranges are desired, the shunt ohmmeter is recommended in place of the series type. It is incorporated in the major diagram and will be discussed more fully in a forthcoming issue.

TO BE CONTINUED

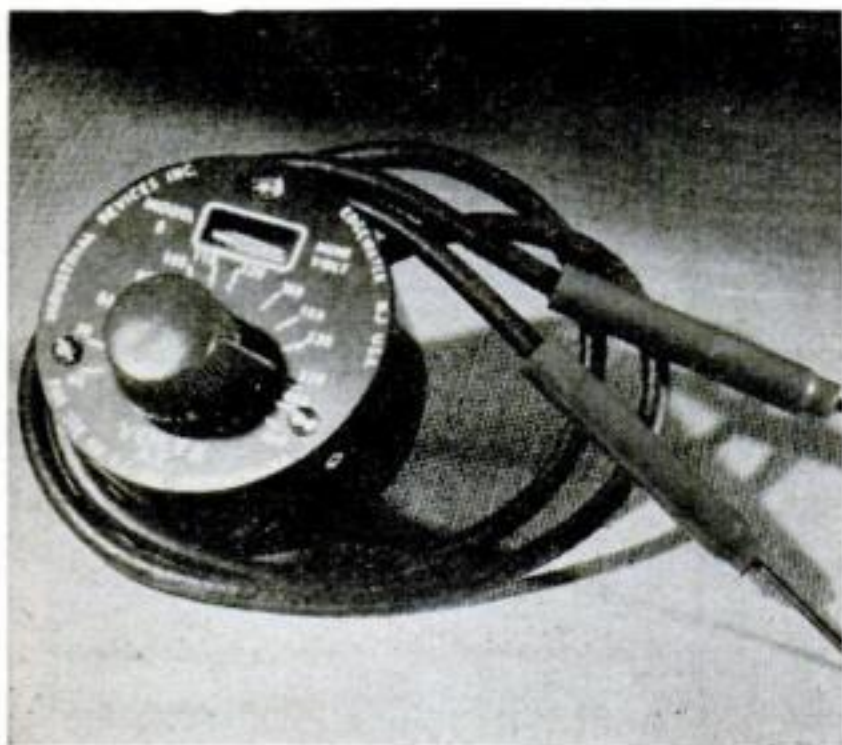
COPPER WIRE TABLE			
No. SIZE	OHMS PER FOOT		MAXIMUM CURRENT MA.
	68°F	77°F	
22	.01615	.01646	1300
24	.02568	.02617	800
26	.04082	.04162	500
28	.0649	.06617	300
30	.1032	.1052	200
32	.1641	.1673	120
34	.2609	.266	80
36	.4148	.423	50
38	.6596	.6726	30
40	1.05	1.069	20





## NEWS IN ELECTRONICS

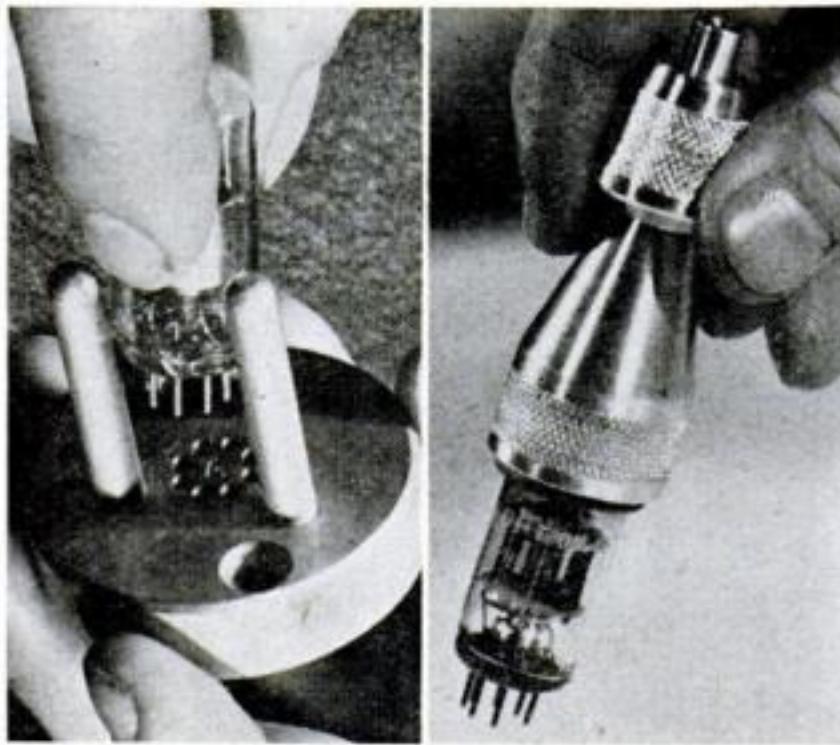
**'Scope Tubes Plug in.** Removing the light shield on the face of this new RCA oscilloscope permits quick interchange of the cathode-ray tube through the front panel. Tubes with different degrees of phosphor persistence may be switched in a matter of seconds, thus giving the single oscilloscope greater versatility.



**Neon Lamp Measures Voltages.** AC or DC voltages from approximately 65 to 660 can be read directly on this miniature neon-glow meter. It is operated by turning the knob of the variable resistor until the neon glow is extinguished, whereupon the voltage is read directly on the scale. The tester, which is said to be accurate enough for most practical applications, is made by Industrial Devices, Inc., Edgewater, N. J. Bulb life is guaranteed for 10,000 hours of actual operation.



**Tuner Brings in FM.** A low-priced adapter which is said to convert any radio or amplifier for reception on the new 88 to 108-mc. FM band is being mass-produced by Pilot Radio Corporation, Long Island City, N. Y. The unit sells for about \$30. It contains its own power supply and a built-in FM antenna.



**Tools Simplify Tube Handling.** Two new devices will make miniature radio tubes easier to use. Because the fine-wire prongs of these tubes are so readily bent out of shape, it is often difficult to insert them properly in their sockets. The gadget shown at the left above solves this problem by aligning the prongs quickly and automatically. At the right is an extractor for hot or hard-to-reach tubes; the glass is gripped by a heat-resistant rubber cup inside the aluminum shaft.



# Boy's Radio Lets Dad Enjoy His



**By Clinton E. Clark**

**E**VERYONE in the family will enjoy this little two-tube headphone set. Junior can listen to all the programs especially meant for him, and Pop and Mom will escape the nerve-shattering tommy guns and thundering herds. Pretuning makes things easy, for any young listener can turn on the switch and set the pointer knob to his choice of three stations. A four-position switch and one extra trimmer would adapt the set to cover all four major networks. Although the circuit is regenerative, pretuning eliminates the usual squeals.

Begin work on the chassis by drilling or punching two 1½" holes for the tube sockets. Then drill holes for mounting the line-dropping resistor 1" in front of the 12J5GT tube. This resistor must be above the chassis because it creates considerable heat.

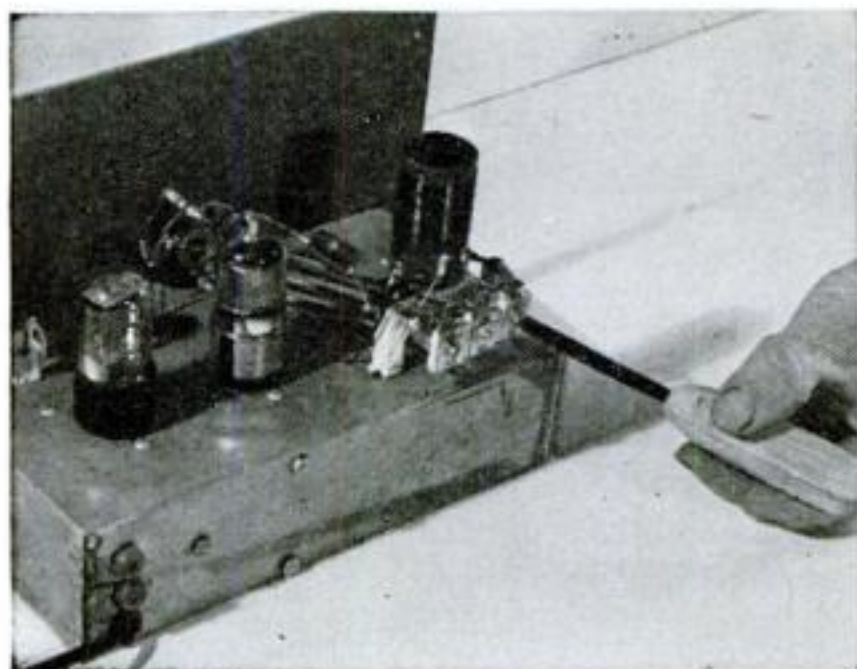
In the back of the chassis, drill three holes



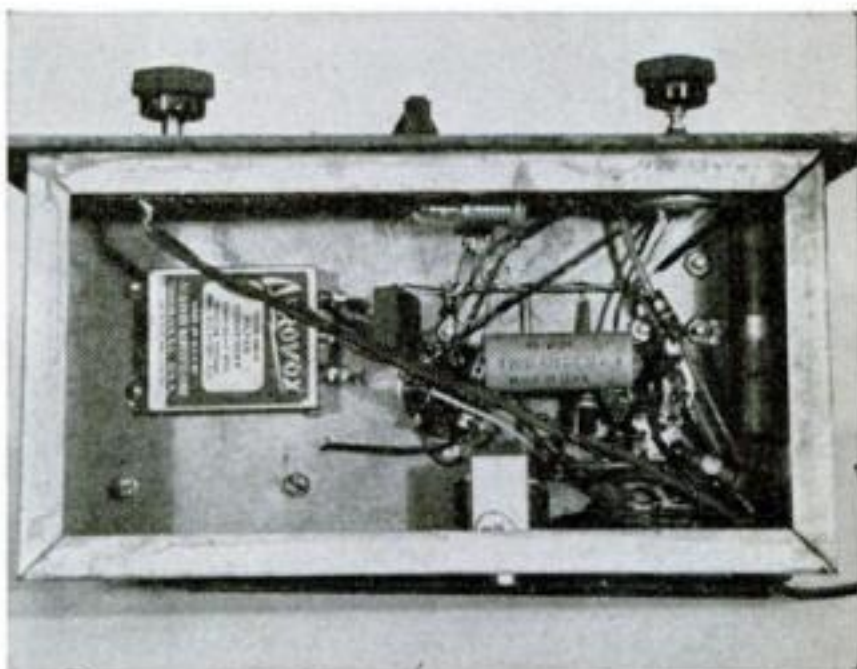
for the phone jacks and line cord, protecting the latter with a rubber grommet. In the front, drill three evenly spaced holes for the switch, pilot light, and regeneration control. Drill three corresponding holes in the panel, plus a fourth for the selector switch.

After the sockets, filter choke, and selenium rectifier have been mounted, the subchassis wiring may be started, taking the power-supply section first. If you have a meter, the DC voltage here should test approximately 100. Then install the filament circuit, and determine the 580-ohm setting of the adjustable slide with an ohm meter.

Mount two 1½" high standoff insulators 2" apart on the left rear of the chassis top. These support the coil and tuning capacitors, a soldering lug being used on the top of each to attach a length of stiff wire to which the condensers are soldered. The other ends of the condensers are brought to



**Pretune the set** with a neutralizing tool or a bakelite shaft ground to a screwdriver tip.

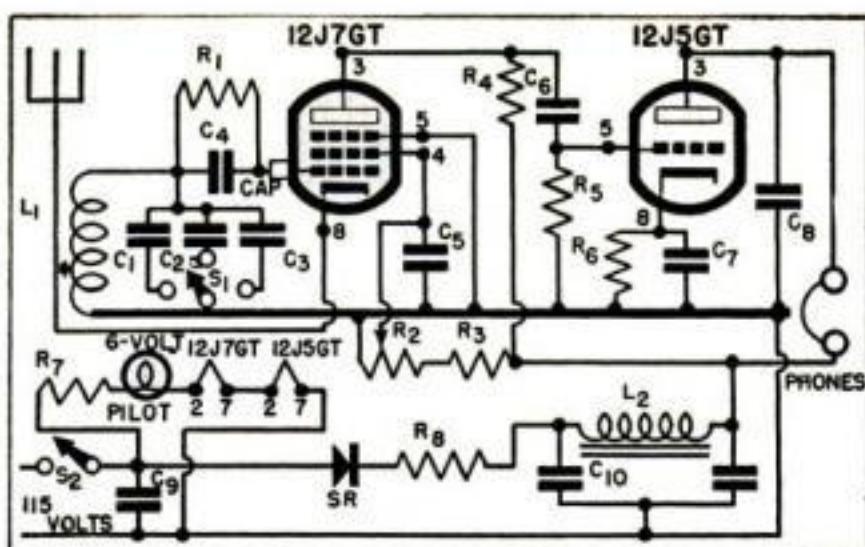


**Subchassis wiring** is comparatively simple. Test the various sections as you go along.



their respective positions on the tap switch. For this receiver, the coil is the type commonly used on small TRF sets, the winding being a single layer. Remove the primary winding entirely.

Experimentation generally will show that the best position for making the cathode connection is near the bottom or ground end of the coil. To locate the exact position, probe with a needle or pin stuck into the eraser on the end of a pencil until you find where regeneration control R2 operates smoothly. Then make a soldered connection. To adjust the tuning condensers, use a serviceman's neutralizing tool, or, lacking



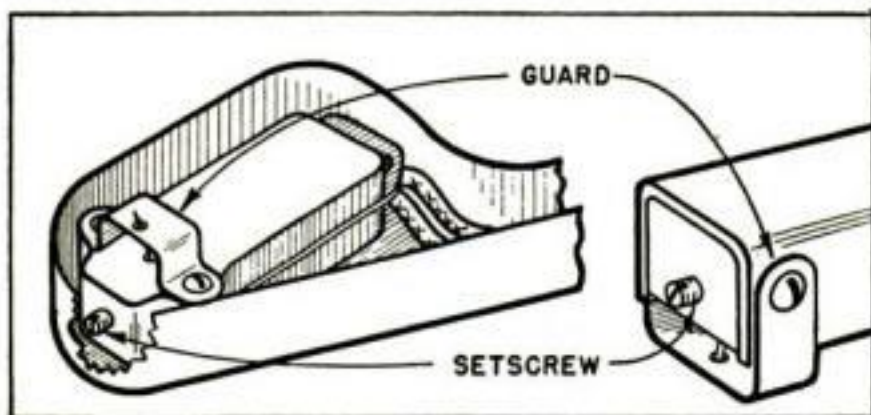
this, a 4" length of bakelite shafting ground to a screwdriver tip. An outside antenna is desirable but not absolutely necessary.

#### LIST OF PARTS

L1: TRF coil.  
L2: 10-hy., 50-ma. choke.  
C1, C2, C3: 400-mmfd. trimmers.  
C4: .0001 mfd. mica.  
C5: 1 mfd.  
C6, C9: .01 mfd.  
C7: 4 mfd.  
C8: .005 mfd.  
C10: dual 20-20-mfd., 150-volt, electrolytic.  
R1: 5 meg.

R2: 50,000-ohm pot.  
R3: 100,000 ohms.  
R4, R5: 250,000 ohms.  
R6: 2,000 ohms.  
R7: 600-ohm wire-wound, 20-watts; adjustable to 580 ohms.  
R8: 100 ohms.  
SR: 75-ma. selenium rectifier.  
S1: Single-pole, 3-position selector switch.  
S2: SPST rotary switch.

### Simple Guard Protects Needle

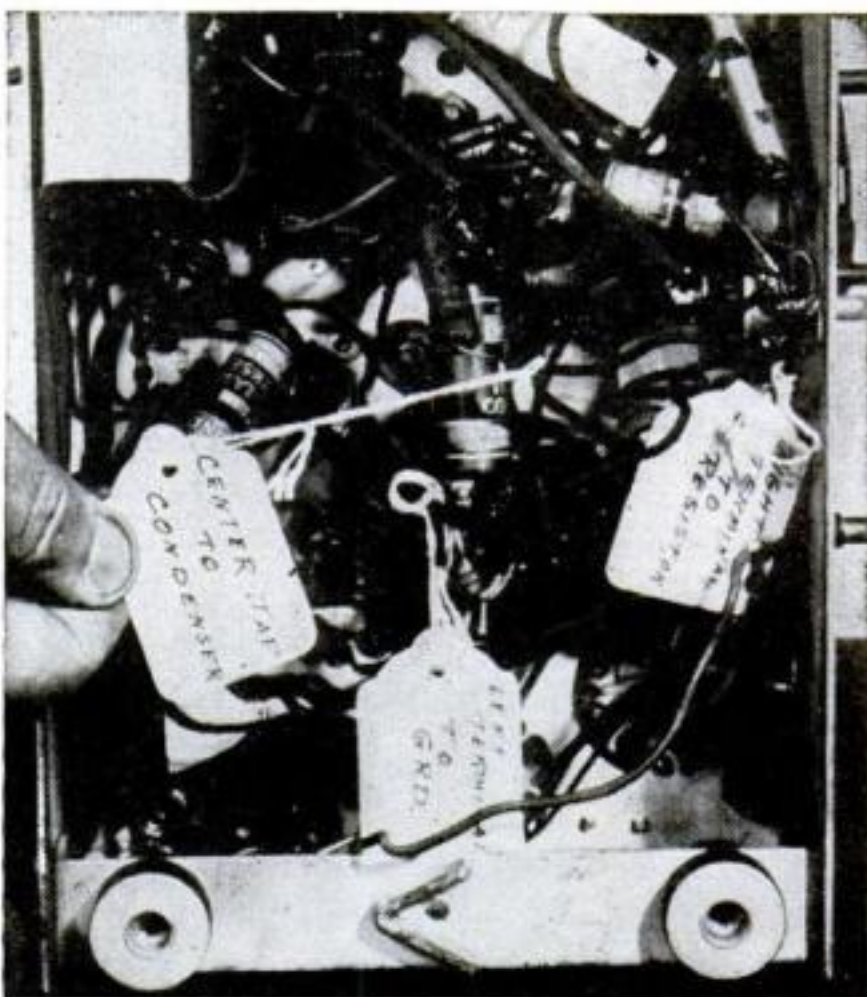


PHYSICAL abuse is a frequent cause of crystal-pickup failure. This may be avoided by installing a permanent-needle type of cartridge with a guard or by building a guard for your present pickup.

An effective guard may be made from a  $\frac{1}{2}$ " by  $1\frac{1}{4}$ " strip of shim brass .005" thick. Drill a  $\frac{1}{8}$ " hole in the center for the needle. Then bend the ends of the strip upward parallel to the needle, and finally, if the arm is the type at the left above, outward so that the ends may be fastened to the bolts that hold the cartridge in place. Drill holes to suit these bolts. Form the guard so the needle projects about  $1/16$ ".

Install a jeweled or other permanent needle and replace the thumbscrew with a setscrew. The arm need not be rebalanced as the weight of the brass strip is not sufficient to warrant it.—MAX ALTH.

### Tagging Wires Saves Time



CONSIDERABLE time may be saved and possible errors eliminated by using price tags to mark the wires when making replacement of radio parts. During reassembly, the tags will show exactly where each wire goes. By erasing the pencil marks, the tags may be used many times. Such tags are available at office supply stores.



## CRAFTSMEN at WORK

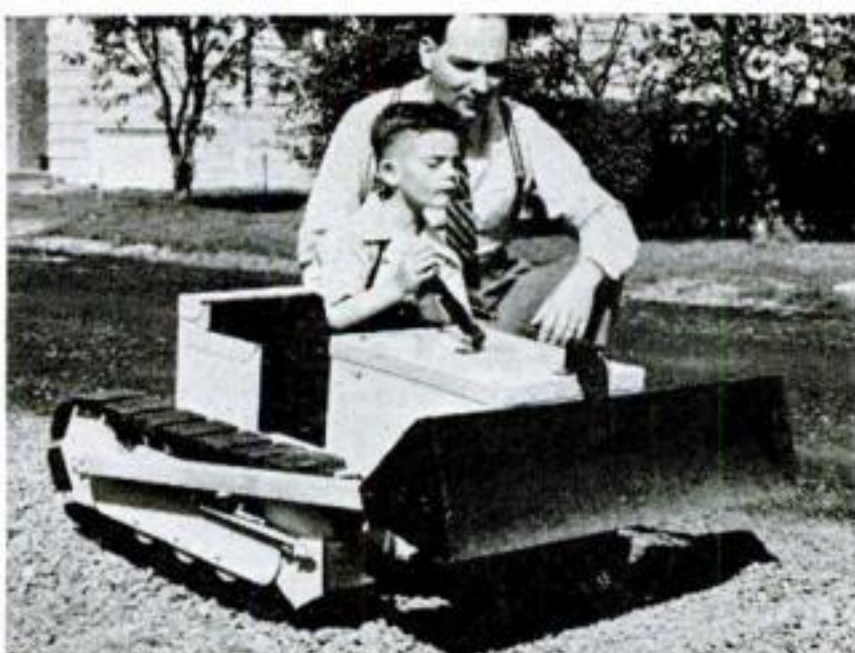


**Wagon Like Dad's.** This coaster wagon, built by A. R. Barringer, of Ruthven, Iowa, for his children, is patterned after an actual farm trailer. Aside from a few bolts, the running gear was made from

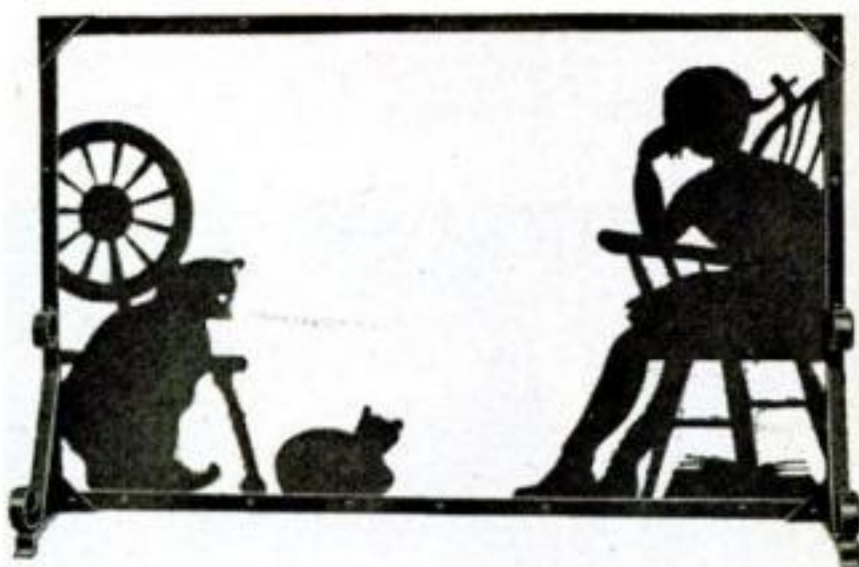


pieces of scrap iron. Radius rods cut from a model T Ford serve the same purpose on the wagon. The reach is adjustable as to length. Tie rods link the handle to the wheels. These and bearings were purchased.

**Spray Outfit Is Portable.** Mounted on a frame of 1½" welded pipe fitted to two wheelbarrow wheels, this spray and grease outfit may be pulled anywhere behind a tractor, car, or truck. It sprays paint, pressure-lubricates farm machinery, and fills tires. Built by Joseph E. Brassal, Jr., of Lockport, Ill., it includes an old street-car compressor of 3.2 cu. ft. capacity operated by a 1½-hp. gasoline engine by a belt drive, a 150-lb. pressure tank, a grease can of 60-lb. capacity, and a spray gun.



**Shoving Things Around.** This miniature bulldozer was built by Jack Cromer, of Seattle, Wash. A control on the hood raises or lowers the blade. Inside controls operate the tracks, allowing them to be used in unison or separately for turning.



**Screen Built from PSM Plans.** This screen was made by Walter J. Stanton, of Norfolk, Va., from plans published in *Popular Science Monthly* (Nov. '44, p. 178), dimensions being suited to his fireplace. The silhouettes were cut from 25-gauge sheet metal. Black heat-resistant enamel was applied to the screen.

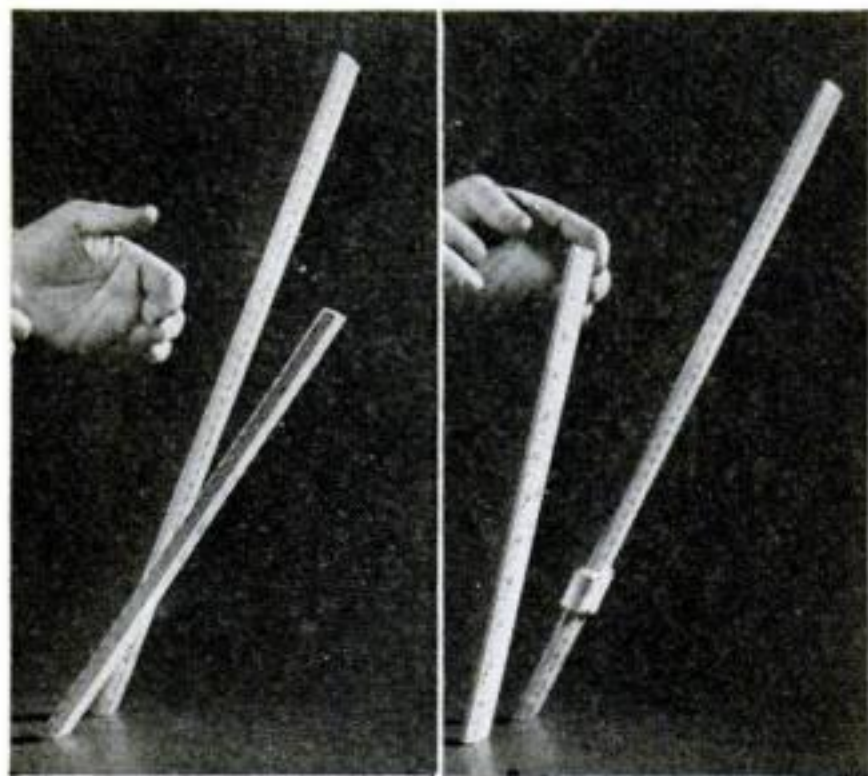




# How and Why Things Balance

**Center of Oscillation.** If you weight a curtain rod by winding wire around it near one end, will it be easier to balance vertically with the weighted end at the top or at the bottom? If you say the bottom, you are wrong. Although it is true that an object is more stable when its center of gravity is near the bottom, another factor comes into play in this case.

Because the base is so small, the object so tall, and the support so unsteady, the rod will fall no matter which end is up. By putting the weight near the top, you shift the *center of oscillation* toward the top. This is the point on the rod that falls as if it were a free-falling body. Thus, if the weight is near the bottom, the rod will fall quickly. But if the center of oscillation is near the top, the rod will require longer to fall. It is therefore easier to balance the curtain rod with the weight at the top because you have more time in which to check the fall when the rod begins to topple over.

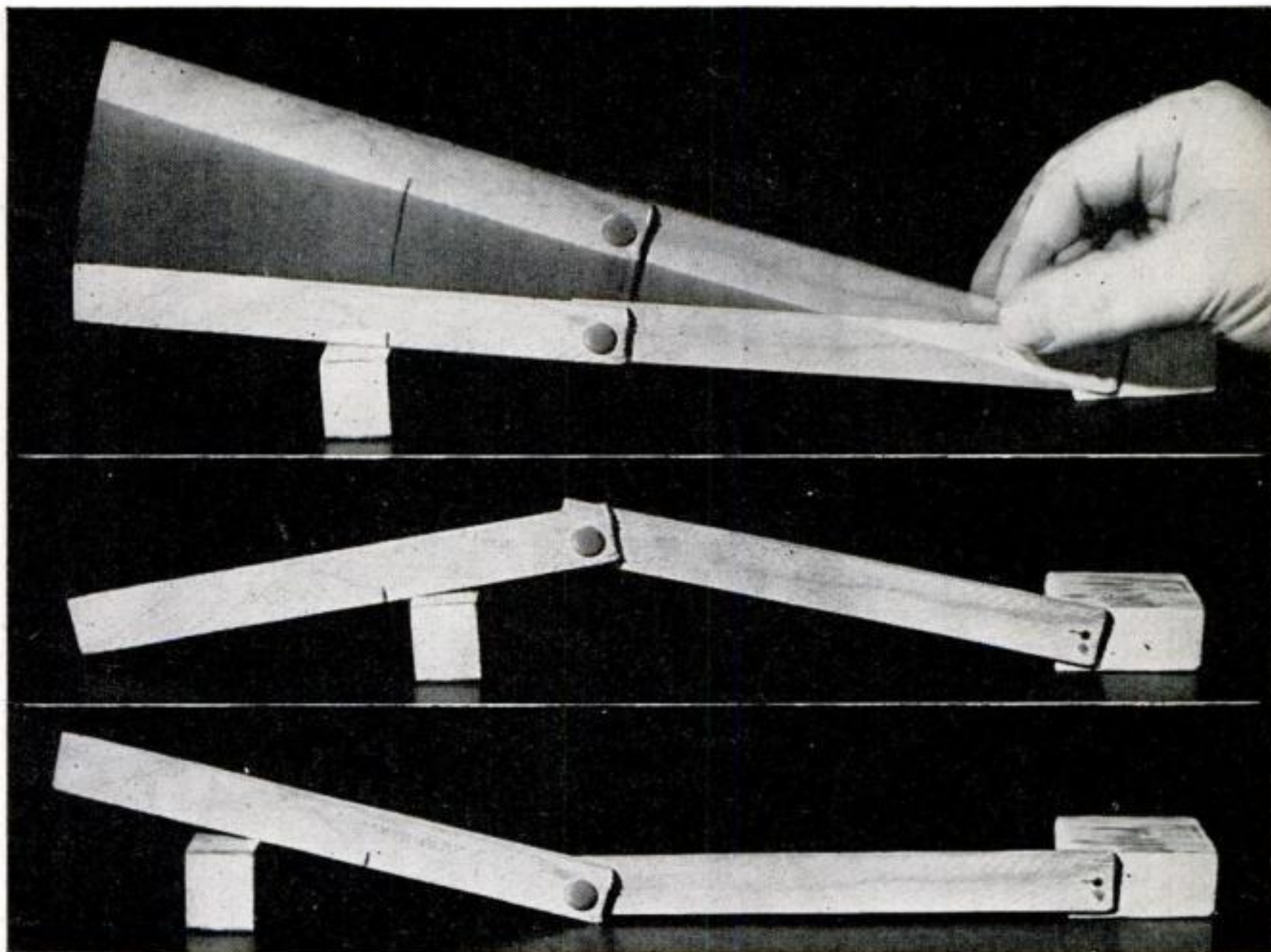


**Fall Varies with Height.** There's a scientific reason for the fact that a child is more apt to fall when he trips than is a tall man. Because the man's center of oscillation is higher, he must fall farther. Hence, he has more time to catch himself.

You may demonstrate that the time required for objects to fall depends upon their height by letting two rulers of different length fall at the same time. If both are of uniform cross section, the shorter will reach the table first, as at the far left.

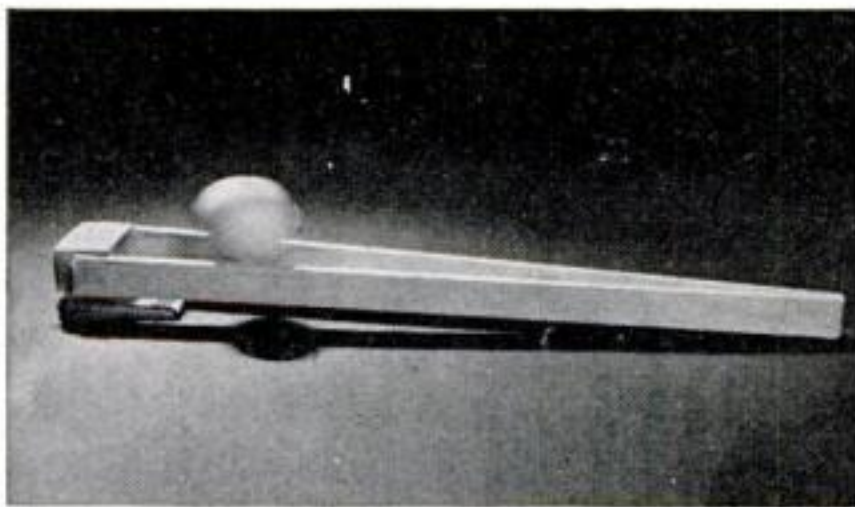
But if the center of oscillation of the longer is shifted to the bottom by weighting it, as in the other photo, it will fall as if it were the shorter ruler.



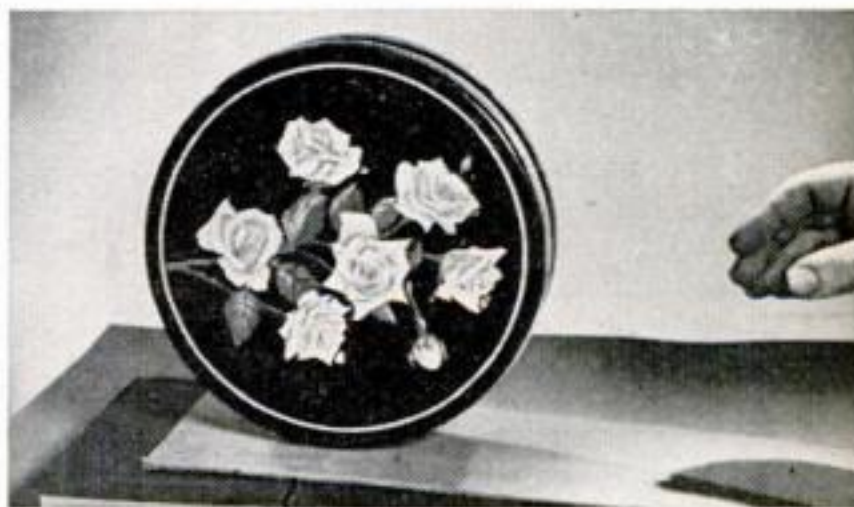


**Center of Percussion.** In a uniform unweighted rod, the center of oscillation is about two-thirds the distance from the point of support. This center is also the *center of percussion*—the point at which, if struck, the rod will not transmit vibration to the support. You may demonstrate this, as at the top, with a stick pivoted in the middle and at one end, the center pivot being just firm

enough to keep the outer half from dropping under its own weight. If you let this compound stick fall so it strikes a block two-thirds of the way from the end pivot, the joint will remain perfectly straight. However, if the block is shifted inward or outward away from the center of percussion, the impact will cause it to buckle in the center, as in the lower photos.



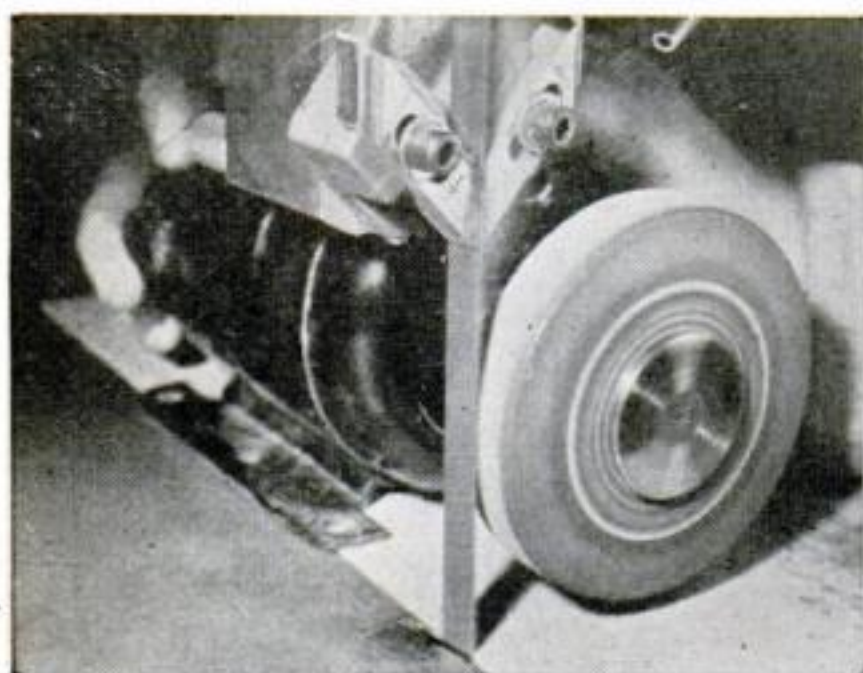
**Ball Rolls Uphill.** Because an object in unstable equilibrium constantly tries to lower its center of gravity, the ball above seems to roll uphill. The wide end of the V-shaped track is higher than the other. Placed at the narrow end, the ball rolls toward the higher because the spreading track allows it to lower its center of gravity.



**Uphill or Down.** A lead weight attached inside this box makes it roll either uphill or down—just as you choose. Secretly note where the weight is in relation to the design. To roll the box uphill, put it down with the weight on top slightly on the uphill side. Keep the incline short so the box rolls only until the weight reaches bottom.



## Knife-Edge Bandsaw Blade Cuts Rubber and Cork



VARIOUS uses may be found for a discarded bandsaw blade ground to a knife edge. It is particularly good for cutting such materials as sponge rubber and cork.

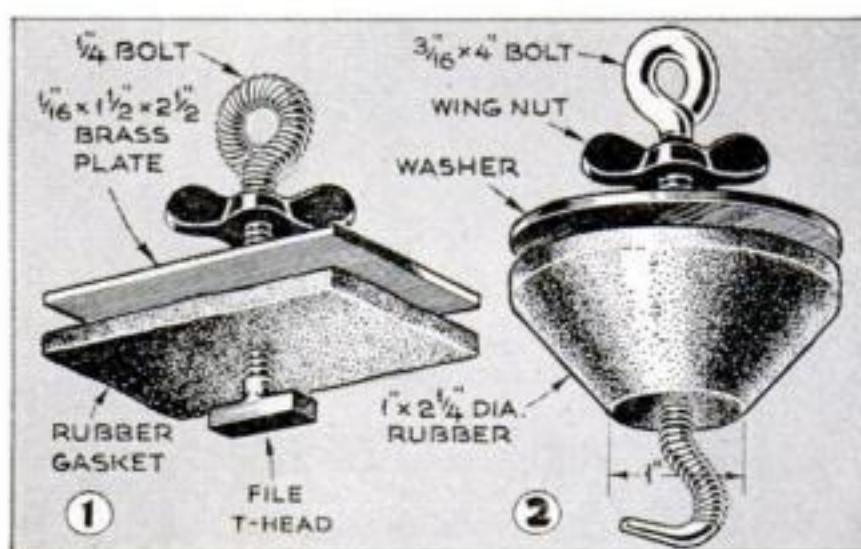
For grinding, mount the blade on the saw, taking care that it is adequately tensioned and tracks properly. Any grinding wheel from  $\frac{3}{4}$ " to 1" wide that can be set on the table will do. Mount it to grind a bevel of approximately 10 deg. on each side of the blade. During the grinding, run the blade at a velocity of 500 to 600 feet per minute. After grinding, make a few passes with a fine oilstone.

## Two Special Gadgets Ease a Plumber's Work

HERE are two homemade gadgets that I have used for many years in my work as a plumber. They should also prove useful around the home when the need arises.

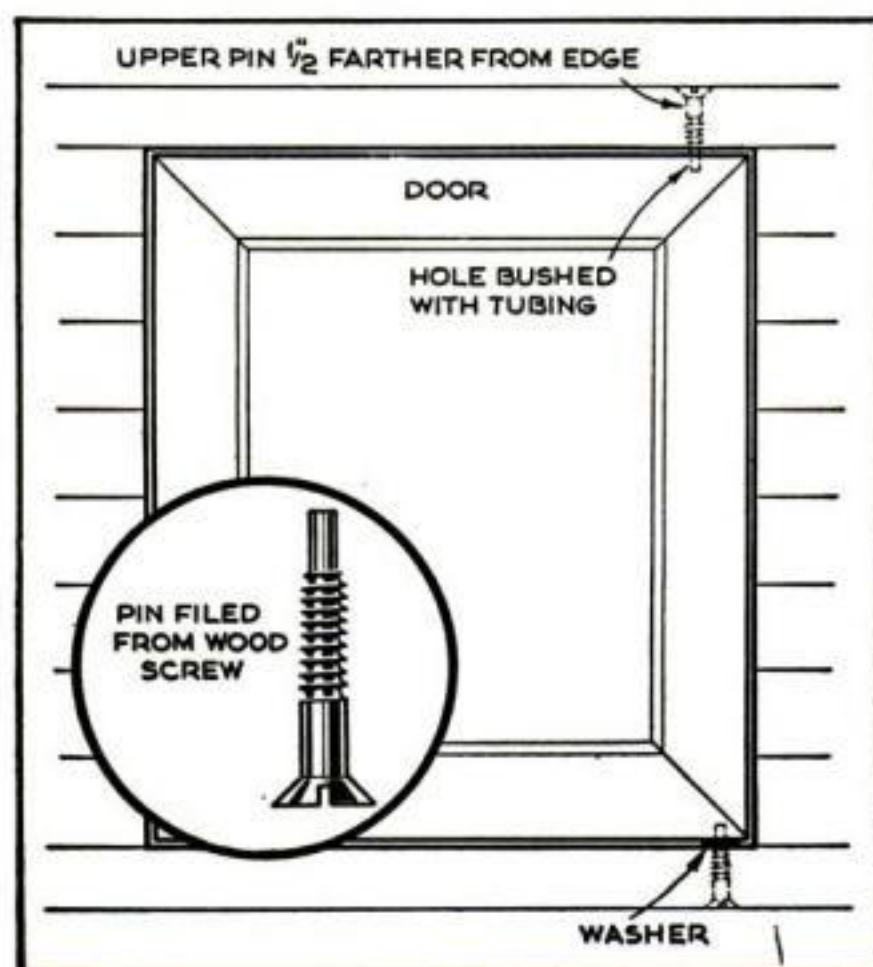
The first is a basin overflow stop. When it is desired to use a plunger pump to clear a drain, the T-head of the bolt is inserted in the overflow opening, given a quarter turn, and the wing nut is then screwed against the brass plate. The gasket thus seals the opening, and the plunger can produce effective suction.

Where there is more than one drain outlet, as in a double washtub, the second gadget comes into use. The hook is engaged under the crossbar in one drain outlet and



the wing nut is screwed down. With this outlet sealed, it is then possible to pump out the drain by using a plunger on the other outlet.—H. A. BARBIER, SR.

## Swinging Door on Dog House Always Closes Again



THERE are no springs on this small swinging door for a dog house, yet it always returns to the closed position after the dog passes in or out.

The secret lies in the fact that the upper pin is  $\frac{1}{2}$ " farther from the edge of the door than the lower pin. Bush the holes that receive the pins with metal tubing to prevent wear.—H. F. HAGELSTON.

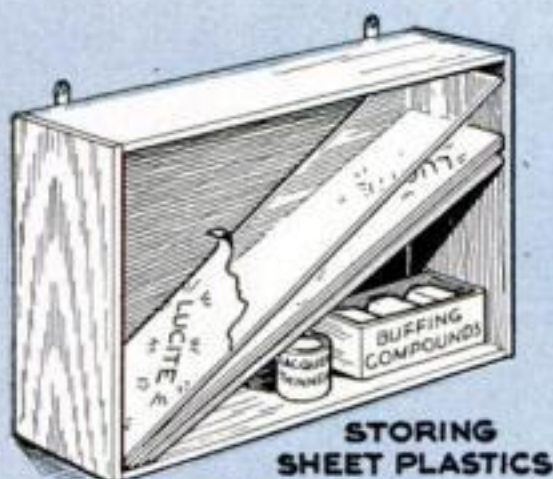
## Suction Cups Prevent Tipping

SUCTION cups screwed to small pieces of wood that are glued to the bottom of a dish will prevent a small child from tipping it. A knife edge releases the cups.

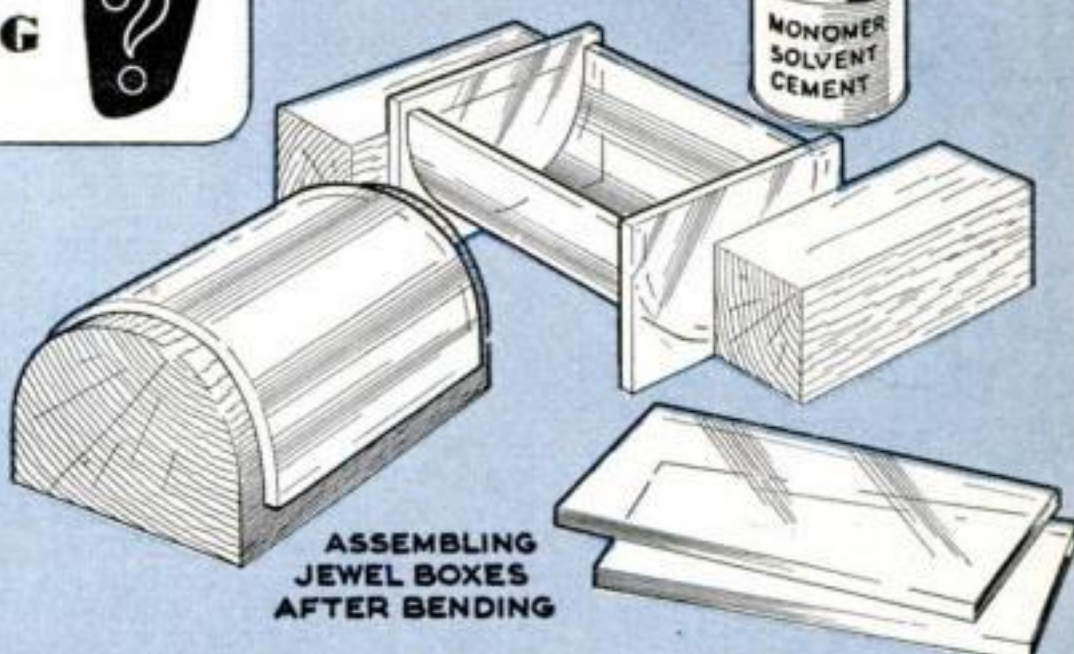




## WHAT'S WRONG ?



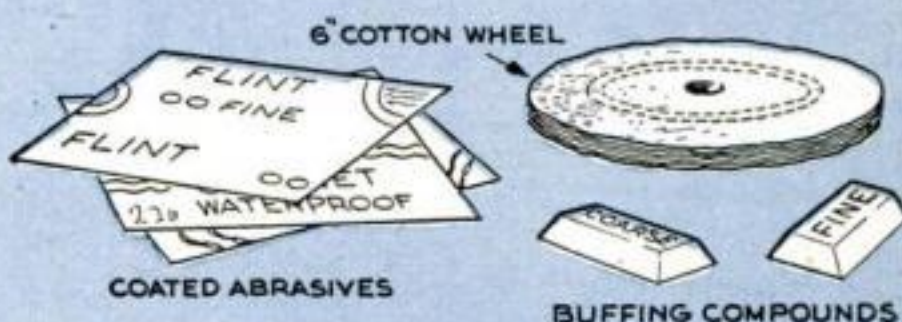
STORING SHEET PLASTICS



ASSEMBLING JEWEL BOXES AFTER BENDING



SANDING A CURVED EDGE



POLISHING MATERIALS

PLASTICS require procedures quite unlike those used for other materials employed by craftsmen. How many mistakes can you spot here? There are three in storing, three in assembling, one in sanding, two in polishing. Check with the answers printed upside down below.

**POLISHING:** The coated abrasives are too coarse; finished-sanding grits should be first 320, then 400, followed by wheel buffing. One buffing wheel is not enough; each grade of buffing compound should have its own.

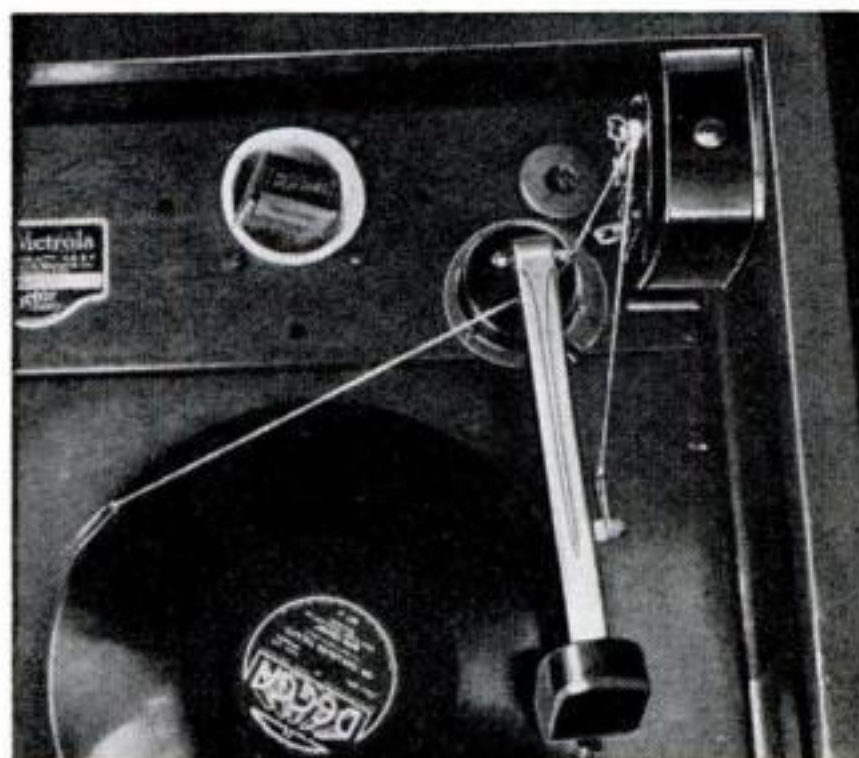
**STORAGE:** Sheet plastic should be stored either flat or on edge; as shown, it will take on a curve. Masking should be left on—even while plastic is worked in some operations. Plastics should not be kept where lacquer or solvent fumes may attack them.

**ASSEMBLY:** Bending deforms the edges of plastic, and they should be sanded square before cementing to a flat piece. Trim the mask from flat pieces only where the joint is to be made; leave the rest to prevent the cement from creeping. Use clamps to hold joints together until the cement sets.

**SANDING:** Masking paper should be left on to prevent abrasion of the surface.

Answers

## Phonograph Alarm Wakes Sleeper Up to Music

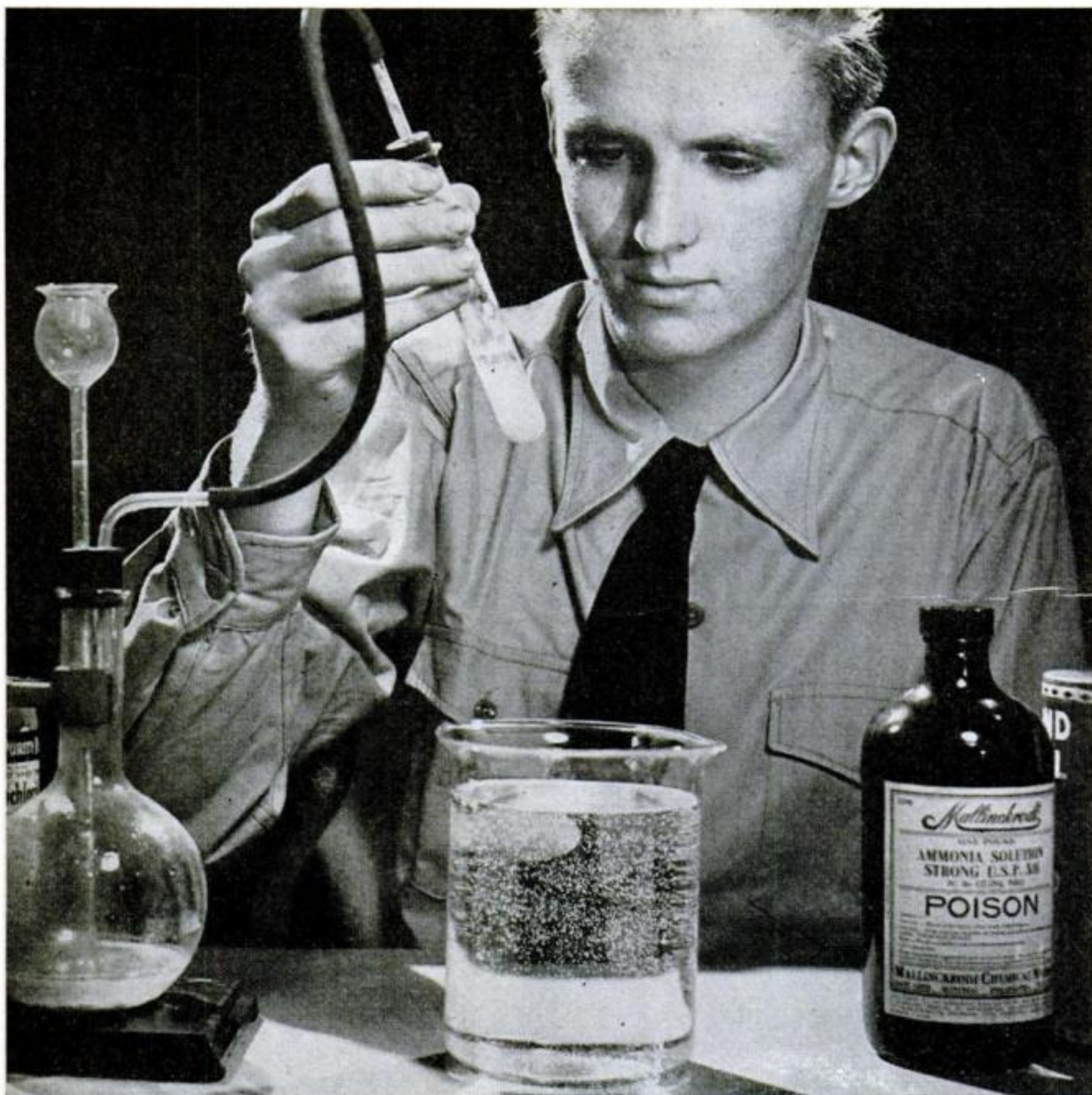


Music has charms to soothe the savage breast—particularly in the morning. Hence, I start my day with a soothing melody.

Each night, I wind my phonograph and rest the tone arm on a favorite record. Then I slip a sewing needle under the felt of the turntable, slip over it a paper clip tied to a piece of string, tie the string to the wind key of a silenced alarm clock, tie a second clip to another string, slip it over the starting lever, and tie this string also to the wind key.

In the morning when the alarm key unwinds, the starting lever is released, and the other string gives a tug to help start the turntable.—G. E. HARRINGTON.





The Solvay process of making sodium carbonate may be demonstrated by leading carbon dioxide to a test tube containing a strong solu-

tion of ammonium hydroxide saturated with table salt. Sodium bicarbonate precipitates in the tube. Heated, this changes to the carbonate.

# Sodium Carbonate Earns Its Salt

**By Kenneth M. Swezey**

**N**EXT to sodium chloride (common table salt), sodium carbonate is the most widely used of all sodium compounds. More than 1,500,000 tons are consumed yearly in the United States as the starting point for compounding other sodium chemicals. An equal amount is used each year to make

glass, soap, cleaning compounds, paper, and leather, to soften water, and to help refine oil. Common washing soda is a crystallized form consisting of 10 molecules of water to 1 of carbonate.

Crude sodium carbonate is called "soda ash" because until about the end of the 18th Century it was made entirely by burning seaweed. Obtained from that source, the



chemical naturally was expensive—as were the glass, soap, and other products made from it. In an effort to reduce the cost, the French Academy offered a substantial financial prize to anyone who could make sodium carbonate cheaply from salt.

Nicholas LeBlanc, an apothecary, solved the problem. By his process, sodium chloride is first reacted with sulphuric acid to form sodium sulphate. Heated with coke, this changes to sodium sulphide. Finally, a reaction between sodium sulphide and calcium carbonate gives sodium carbonate.

The LeBlanc method went unchallenged until 1863, when the Belgian chemist Ernest Solvay introduced his famous ammonia-soda process, now used to produce 90 per cent of all sodium carbonate that is made. The Solvay process is an outstanding example of a complex reaction in which all the by-products are either re-used or sold.

In practice, a saturated solution of salt is treated with ammonia and carbon dioxide. Ammonium bicarbonate forms, but this immediately reacts with the salt, producing sodium bicarbonate. As the latter chemical is only slightly soluble in the brine, it precipitates out. Removed by filtering, the bicarbonate is dried and then heated to change it into the carbonate. Ammonia and part of the carbon dioxide are recovered for use again. The by-product, calcium chloride, is used as a drying agent, to settle highway dust, and as a refrigerating fluid.

You can demonstrate this process with table salt, concentrated ammonium hydroxide, marble chips, hydrochloric acid, and calcium hydroxide (slaked lime).

Dissolve all the salt you can in 10 ml. of 28-percent ammonium hydroxide solution, filter out any excess salt, and pour the clear solution into a test tube. Provide the tube with a one-hole stopper that has a glass outlet tube in it. Then set up a carbon dioxide generator. This consists of a flask with a two-hole stopper. In one hole, insert a thistle tube that reaches almost to the bottom of the flask. In the other, place a short delivery tube. Sprinkle some marble chips over the bottom of the flask and cover with about  $\frac{1}{2}$ " of water. This done, start the generator by pouring a little concentrated hydrochloric acid into the thistle tube. After allowing the gas to bubble for several minutes to drive the air out of the flask, connect the generator and the test tube with a length of rubber tubing.

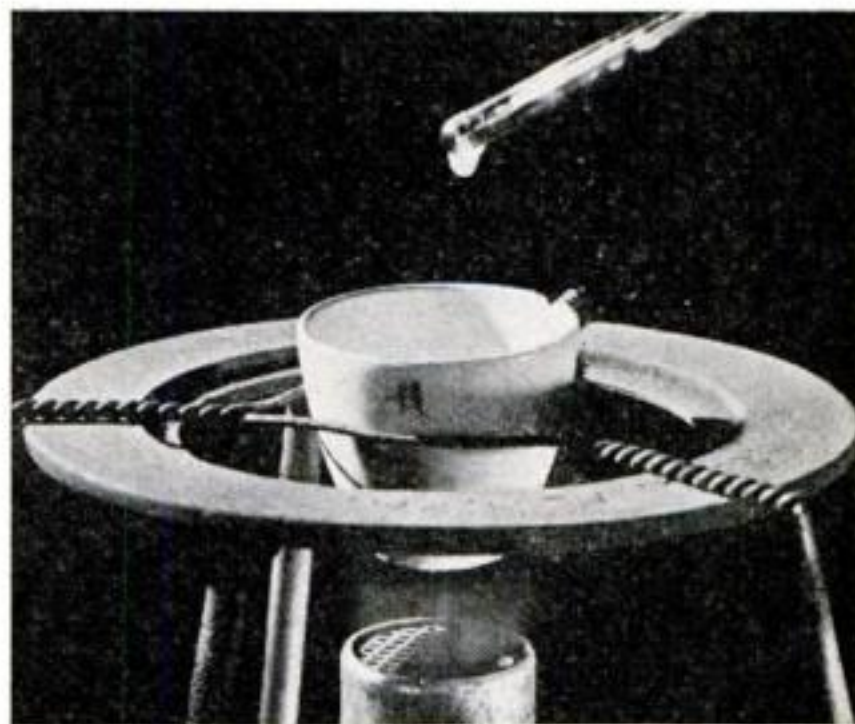
At first, stopper the test tube lightly so



**Bits of dry ice** shaken in a strong solution of ammonium hydroxide saturated with table salt will also yield sodium bicarbonate. This may then be changed into the carbonate as below.

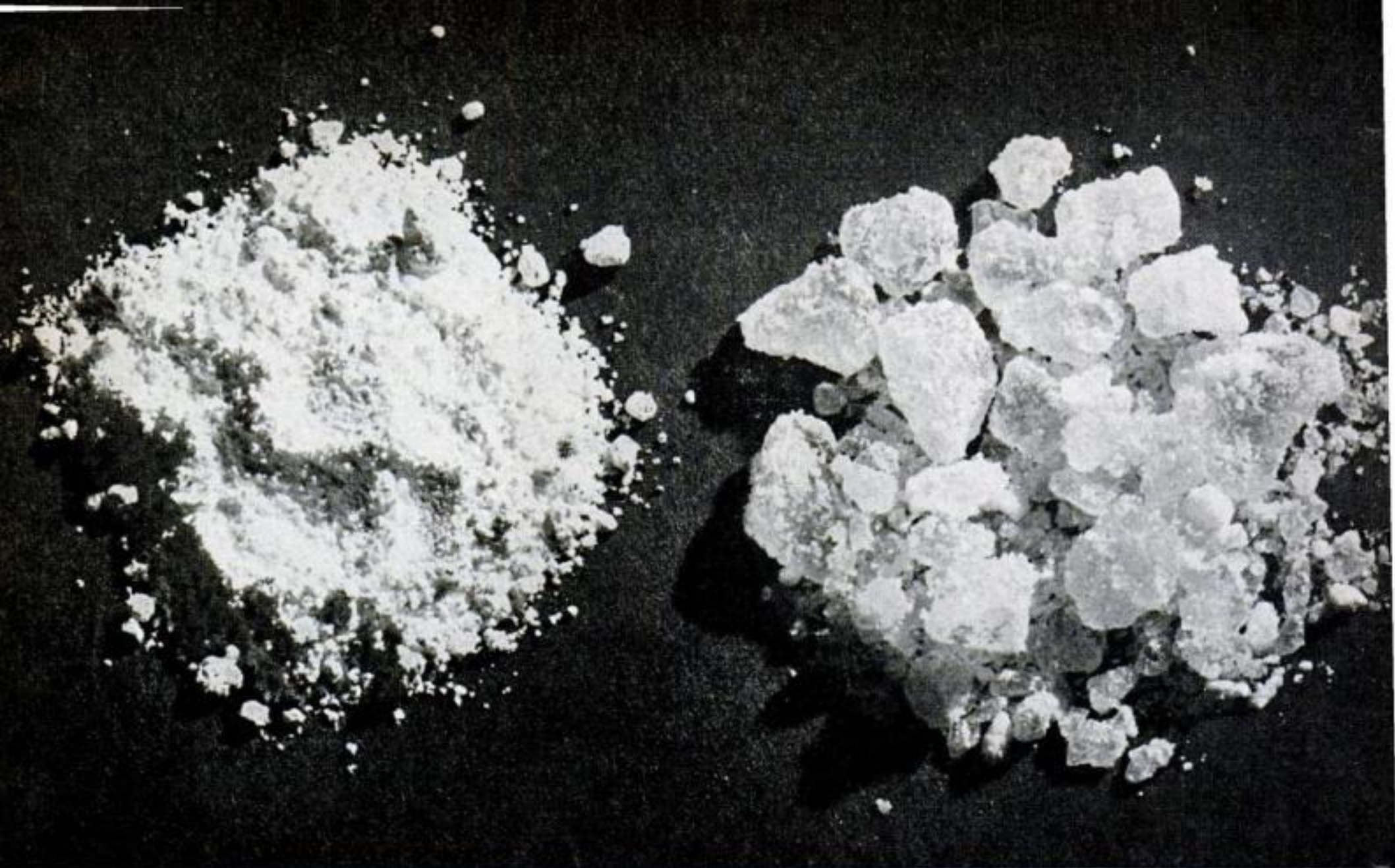


**Sodium bicarbonate** precipitated in the flask at the top of the page or the tube opposite is filtered out. It then should be washed with small quantities of ice water, as seen above.



**After drying, heat** the sodium bicarbonate in a porcelain crucible. This turns it into the carbonate. A drop of limewater held over the crucible proves carbon dioxide is given off.





**Two common forms** of sodium carbonate are seen here. At the left is soda ash, a grayish-

white powder. Washing soda, right, is a crystalline form, each molecule having 10 of water.

that air is driven out. Then stopper tightly and shake vigorously. The fact that the carbon dioxide is under slight pressure helps it react with the solution. When the rising liquid reaches the thistle, loosen the test-tube stopper slightly to reduce the pressure. Since the reaction produces heat, cool the test tube between shakings by immersing it in cold water.

Within a few minutes, a heavy white precipitate of sodium bicarbonate will form in the tube. Separate this from the solution by filtering. Then, to remove traces of ammonium chloride, wash it in the filter by pouring a succession of very small portions of ice water through it.

If solid carbon dioxide, or "dry ice," is available, the sodium bicarbonate can be made even more simply. Drop a few small pieces into a flask that contains the solution of ammonium hydroxide saturated with salt. Then shake the flask, holding it in the palm of one hand and closing the mouth with the other. Lift the upper hand occasionally to prevent too high a pressure. When the sodium bicarbonate precipitates, filter and wash it as described before. You then are ready to change the bicarbonate into the carbonate.

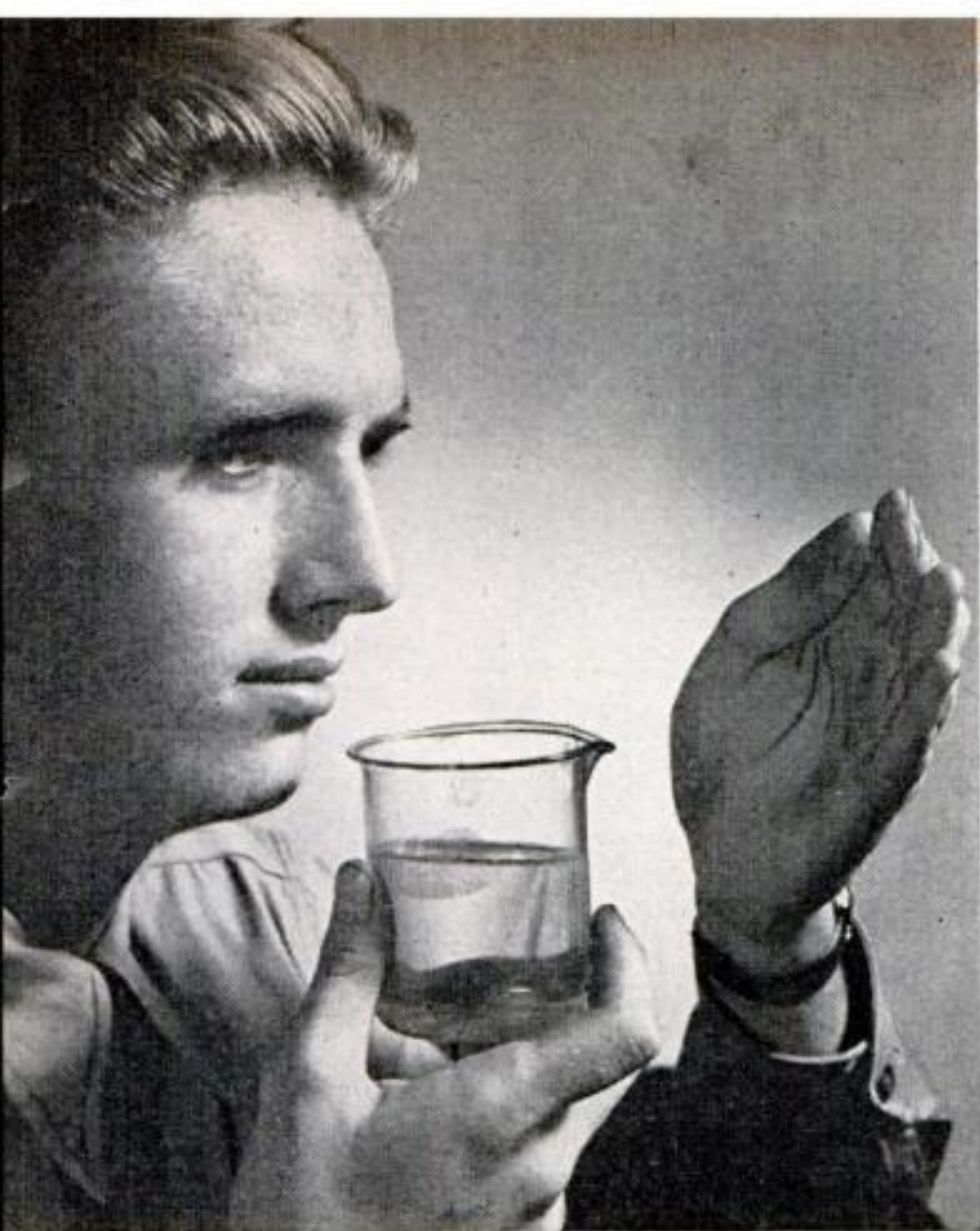
Although great quantities of sodium bi-

carbonate (ordinary baking soda) are used in making baking powders, in medicines, and as a source of carbon dioxide in fire extinguishers, this product is usually not sufficiently pure when it comes from the ammonia-soda process. Nearly all of it, therefore, is transformed into sodium carbonate by heating, or *calcining*—even though eventually some of it must be changed back.

Commercially, the calcining is done in huge rotary furnaces, with the fires outside, but you can do it on a small scale in a porcelain crucible. First, dry the sodium bicarbonate between pieces of filter paper and finally in the air. Then, fill a crucible about one-fourth full and heat it rather strongly. While heating, hold over the crucible a glass rod with a drop of limewater on its tip. The limewater will quickly turn milky, a test that carbon dioxide is being given off. After being heated for several minutes, the bicarbonate will have turned into the carbonate.

One difference between sodium bicarbonate and sodium carbonate may be shown by adding a few drops of phenolphthalein solution to a solution of each. By hydrolyzing, or combining partly with water, to form sodium hydroxide, sodium carbonate reacts as a moderately strong alkali, turning





**Ammonia is freed** from a solution of ammonium chloride when a little slaked lime is added.

the solution a deep pink. Except when heated, sodium bicarbonate scarcely hydrolyzes. It produces only a faint coloration.

As already mentioned, the ammonia required in the Solvay process may be used over and over again. Otherwise, the process would be a failure, for the ammonia needed to produce 1 lb. of sodium carbonate costs more than the carbonate itself. How this gas can be removed from the ammonium chloride solution remaining after the sodium bicarbonate has been filtered off may be demonstrated by adding a little slaked lime. The reaction forms calcium chloride and ammonium hydroxide, and the ammonia, freed by heating, may be smelled by wafting the vapors toward your nose.

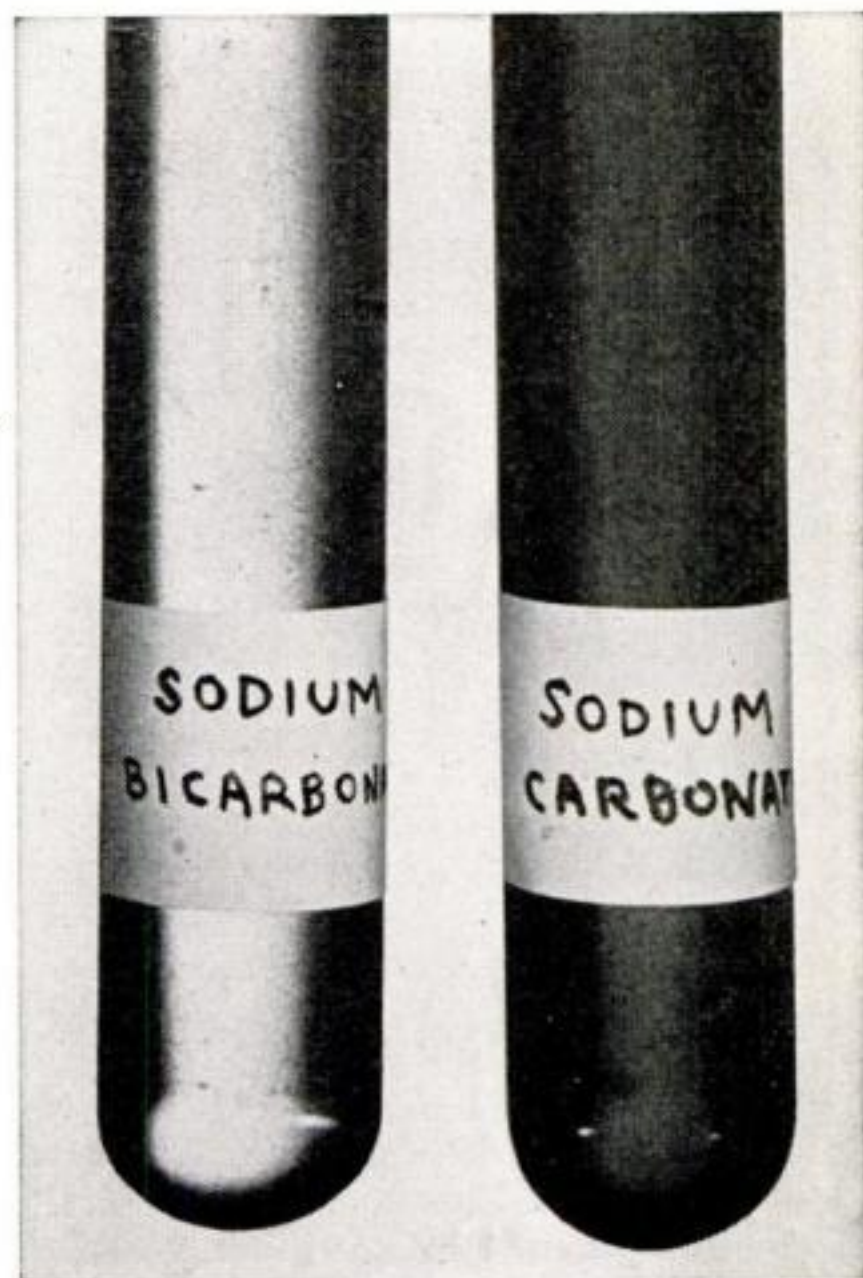
Soda ash, the crude sodium carbonate of commerce, is a grayish-white powder. Washing soda is made by dissolving this in water and then allowing the water to evaporate until crystals are formed.

Caustic soda, or sodium hydroxide, is sometimes made from sodium carbonate by treating a solution of the carbonate with a solution of calcium hydroxide. You can do this yourself to see how it works. A white cloud of calcium carbonate will be precipitated. The sodium hydroxide remains in solution.

END



**Adding a solution** of calcium hydroxide to one of sodium carbonate gives sodium hydroxide.



**One difference** between sodium bicarbonate and carbonate is seen if phenolphthalein solution is added to a solution of each. Carbonate, a moderately strong alkali, turns a deep pink.





## Kitchen Cupboard Has Disappearing Vegetable Bin

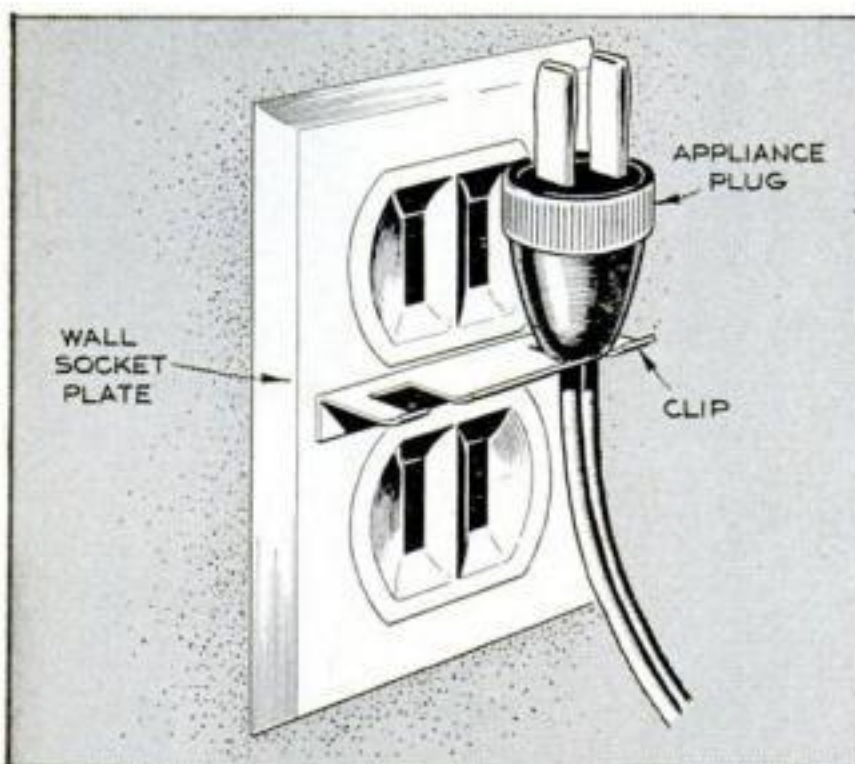
BESIDES holding its quota of cans, jars, and bottles, this handy kitchen cabinet has a tilting vegetable bin that can be opened or shut with one hand, stays in either position, and lifts out for cleaning.

The cupboard shown was built from part of an old bookcase. You can start from scratch, though, by nailing together 10"

boards into bookcase form with butt joints. Since a kitchen piece is usually enameled, old or knotty lumber will serve. Nail  $\frac{1}{4}$ " plywood or wallboard on the back. Grooves for the sliding doors can be plowed with a rabbet plane, built up on the edges of the horizontal boards by nailing on first a narrow and then a wider strip, or formed by bradding quarter-round molding to the underside of the top board and the top of the lower board. Make the door panels of such a size that they can be raised in the top groove and lifted out for cleaning.

For sturdiness, the bin should be assembled with glue and wood screws. It pivots on two dowels set in the ends of the cabinet 3" from the front edge. The dowels seat in notches cut in the endpieces of the bin, as seen in the photo at the left above. The extra holes are for ventilation; similar ones should be bored in the cabinet ends.

When in, the bin rests on two blocks behind the pivot pins. When pulled open, it is stopped by the sloping cross member set in solidly below the shelf.—R. HOPPOUGH.



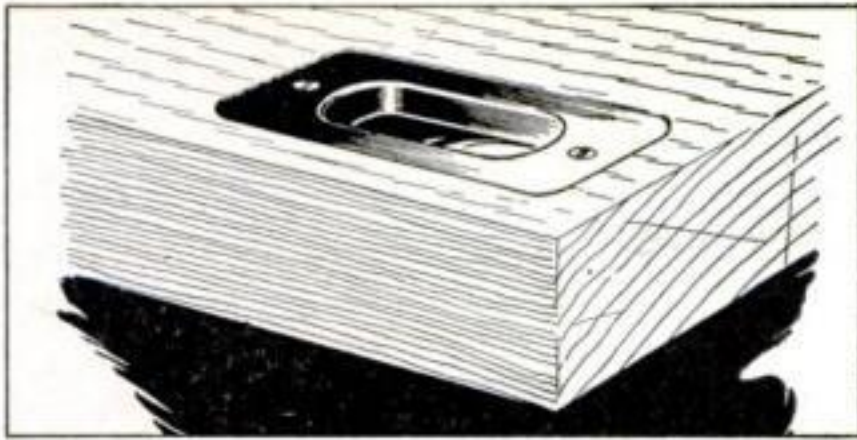
## Clip Holds Appliance Plug

IF A plug must be detached from a wall socket when an electrical appliance is not in use, this clip will make it unnecessary to stoop down each time you want to use the appliance. Notch a piece of metal to receive the cord, bend to a 90-degree angle, drill a hole, and mount on the socket plate by the plate screw.—W. B. EAGAN.

## Jar Stores Composition Wood

PLASTIC composition wood bought in cans usually dries out no matter how tightly the top is pressed on. As a solution, I now store the can inside a large-mouth glass jar with a screw top, turning down the top against a gasket made from oiled paper. Stored in this way, plastic composition wood remains moist for many months.—A. S. JAMIESON.





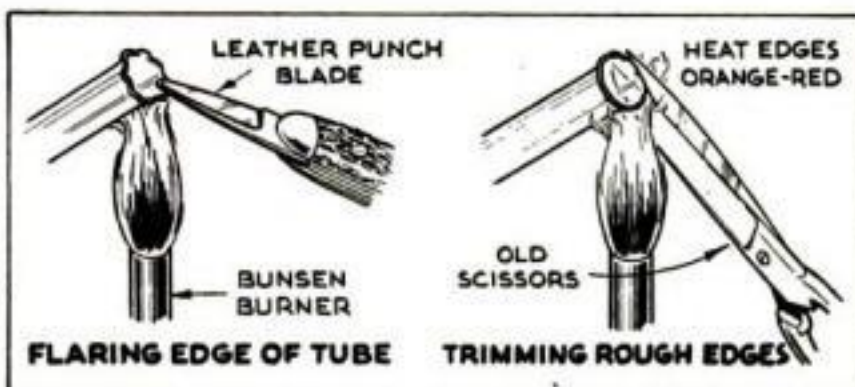
### Workbench Trough Is Handy

SET in a recess cut into the corner of the workbench, a metal trough will be found convenient as an ash tray or to hold small parts. One of the troughs used on sliding doors is good for this.—FRANK SHORE.

### Test Tubes May Be Repaired

TEST tubes that have broken near the top may be returned to use by the method illustrated below. First, heat the jagged edges and flare them out by pressing with the leather-punch blade of an old jackknife or a similar instrument.

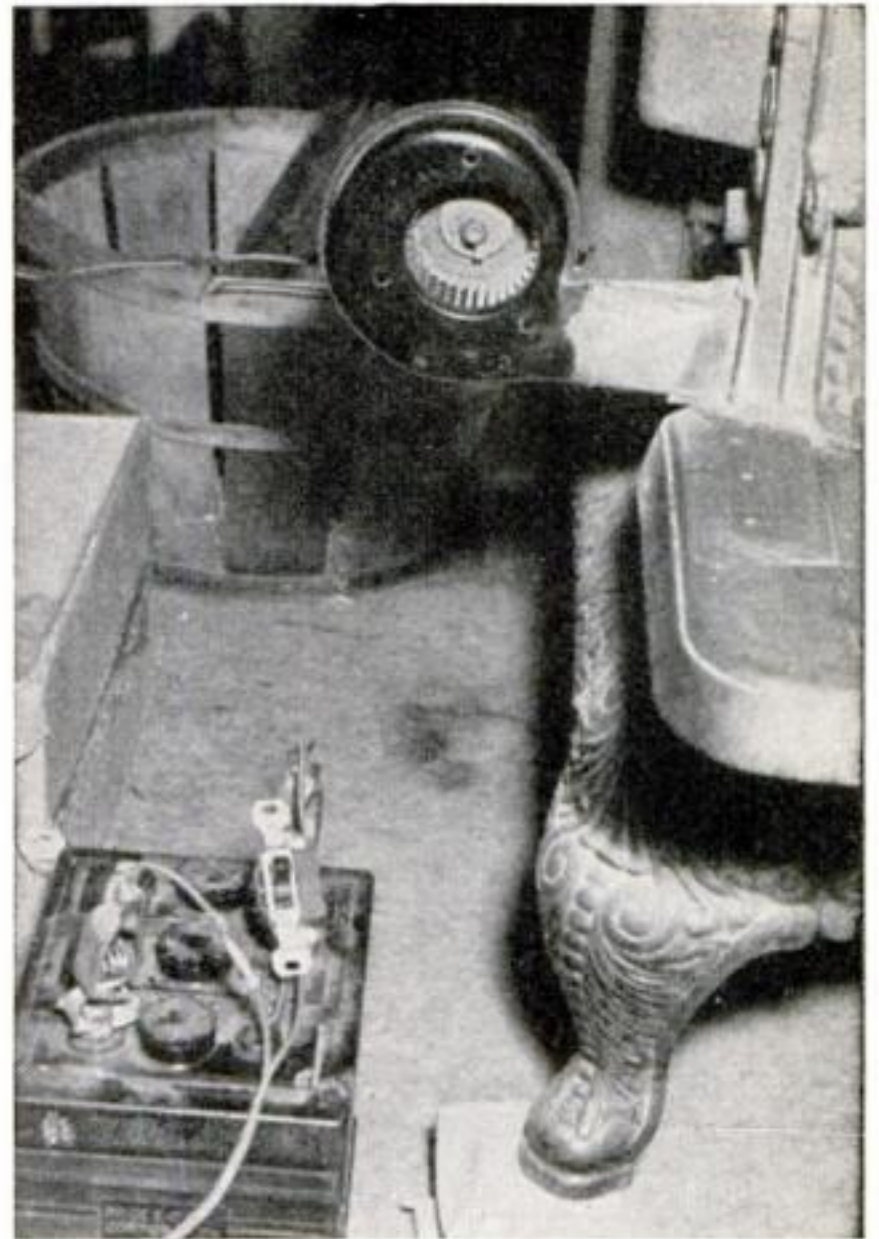
After this, heat each sharp point to an orange color and trim off with an old pair of scissors. Finally, turn a bead with the punch blade, and fire-polish. It is not necessary that either the knife or scissors be as hot as the glass, although a cleaner job can be done if the tools are heated to some extent.—JOHN L. STORY.



### Spring Keeps T-Square Square

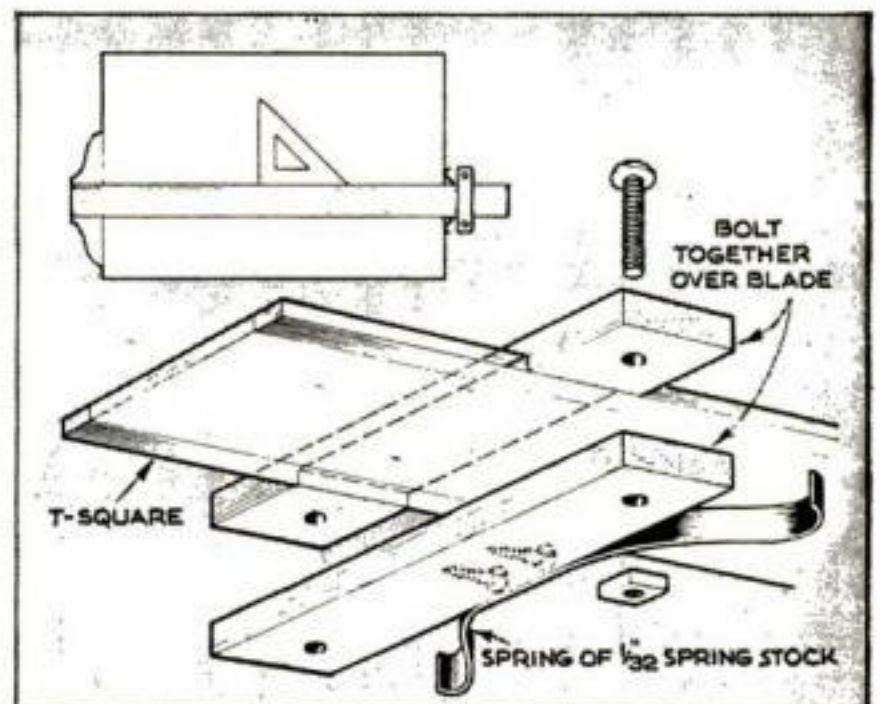
ANY T-square can be converted into a parallel ruler with the attachment illustrated at the right. It also allows a draftsman to have both hands free, for the T-square is held firmly against the board.

It may be made from light wood, metal, or plastic, the dimensions being suited to the thickness and width of the particular T-square. In one piece, cut a groove as wide as the blade of the square, but not quite as deep. To the other piece, attach a short length of  $1/32$ " spring stock. Bolt the two pieces over the blade.—JOSEPH F. GRECE.

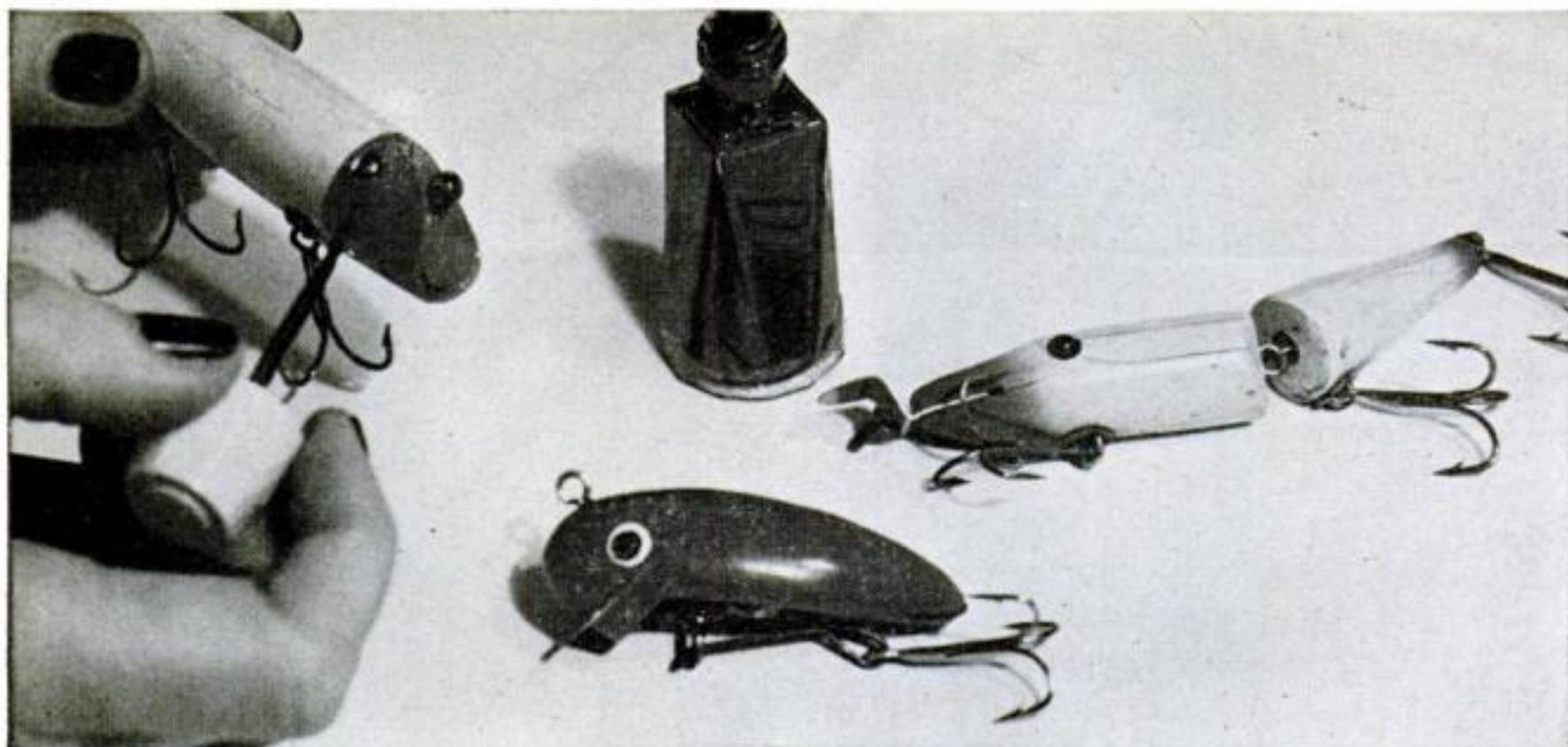


### Fan Heats Coal Range Quickly

THE coal range in the kitchen of our country house did not draw well, probably because the chimney is a bit too low. Some sort of forced-draft system was obviously the answer, but since the house is not electrified and I couldn't locate a satisfactory 6-volt blower, I was stumped for a time. Finally I hit upon the idea of taking the fan and motor from an old car heater. Connected by a tin can to a hole cut in the ash pit and powered by our radio storage battery, this rig now quickly makes the stove top red hot or brings the oven to baking temperature.—E. V. COLLINS.







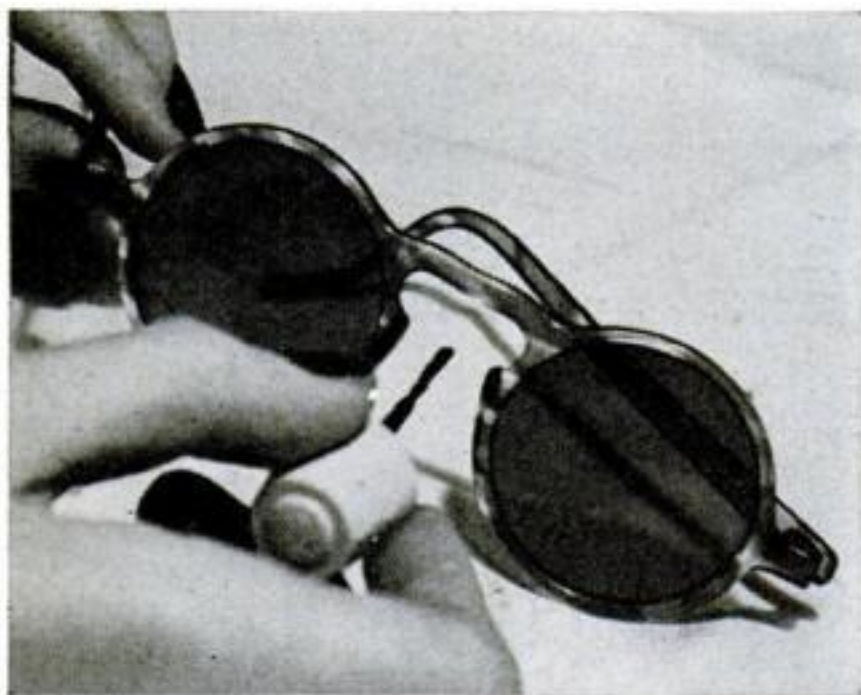
Those old plugs may catch more fish if their red heads are brightened up a bit. Try a dab

of polish on some of the duds that never did catch on. It could be all they really needed.

## Handy Nail-Polish Hints

**O**N THE beautiful hands of a woman or in the skilled hands of a man, nail polish can be one of the most useful as well as decorative of household items. In addition to the colorless variety and the myriad shades of red, it comes in blue, green, and other colors. Try it as a touch-up enamel on canisters, cord pulls, kitchen clocks, and knickknacks. If you have the skill and a fine brush, you can work up some pleasant designs for your glassware and ashtrays.

Nail enamel dries quickly and you don't have to be afraid of making mistakes; if you do, just trot out the polish remover and try again. Soap, water, and alcohol normally do not affect it, but where it will be subject to hard wear, an extra sealing coat is recommended. If you want a few tips on how to use it, take a look at these pictorial suggestions by F. Brady and Kenneth Murray. You will find that nail polish adheres well to practically any dry surface.



**A new note in sportswear.** You can give the frames of your old sun glasses a real lift with a coat of dark red or blue lacquer. Earpieces may be the same or a different color.



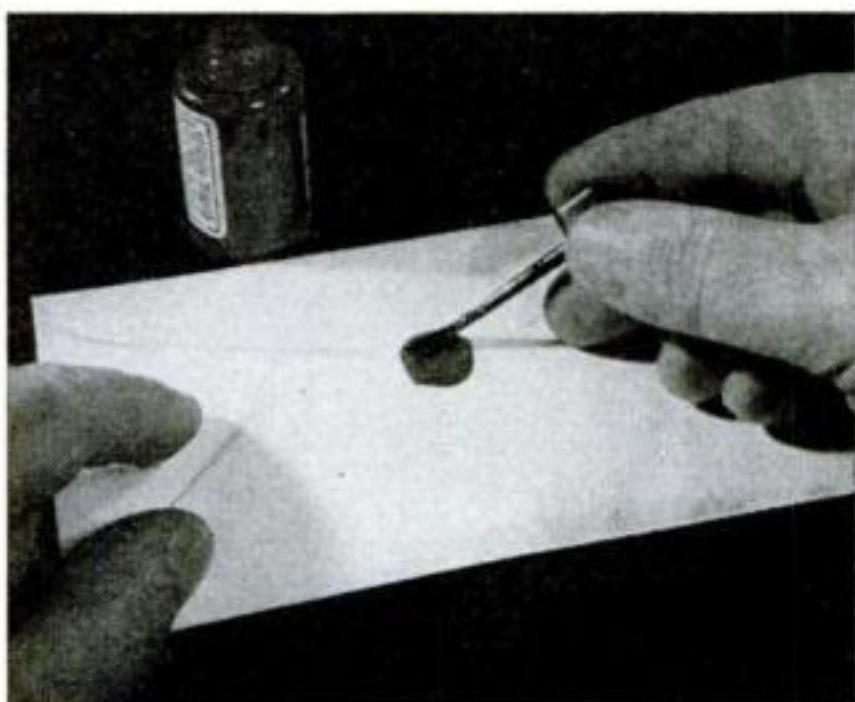
**Feeding bowls for your pet** can be decorated with good effect, and if you have more than one animal to take care of, there's nothing like labeling dishes to keep them separated.



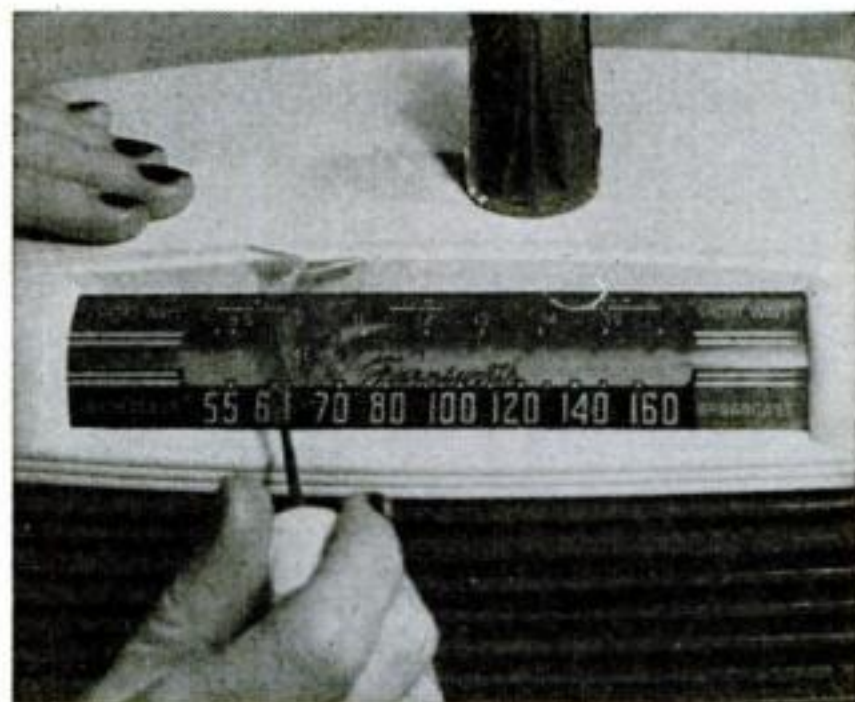


**Guests will appreciate** individually labeled party glasses that won't get switched around.

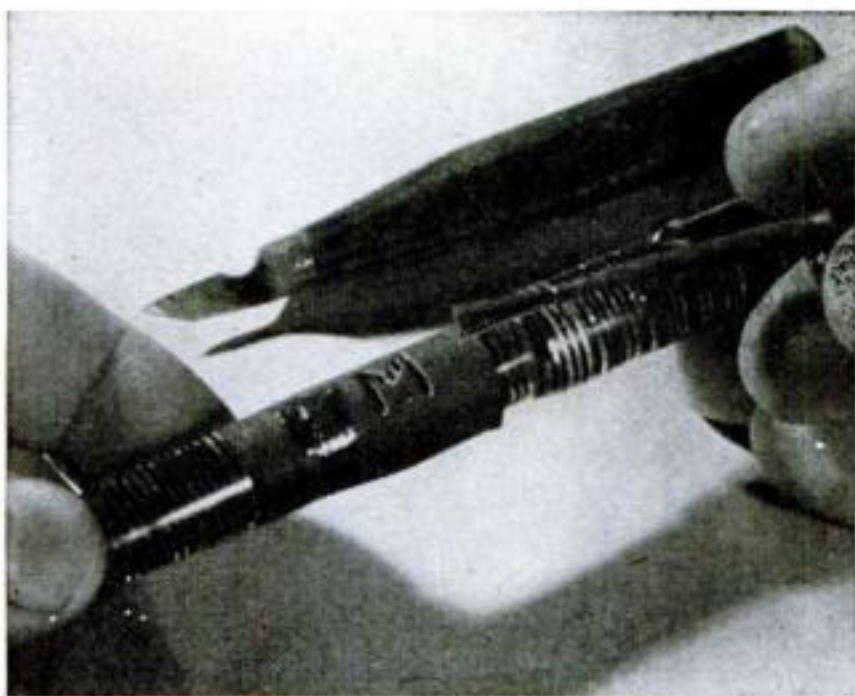
Marking cocktail ingredients on the outside of the shaker makes a perfect round every time.



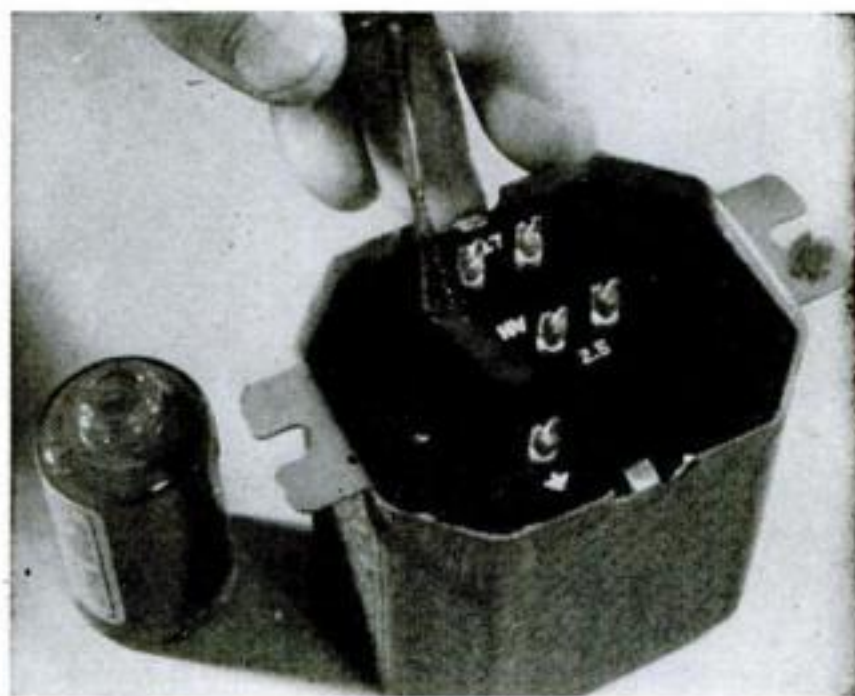
**For sealing important letters,** try a dab of thick nail polish in place of sealing wax. It doesn't have to be warmed in a flame, is flexible when dry, and adheres as well as wax.



**Locate favorite stations** on a radio dial with arrows painted between convergent cellulose-tape masks. Don't use remover if the original lettering is on the front of the dial window.



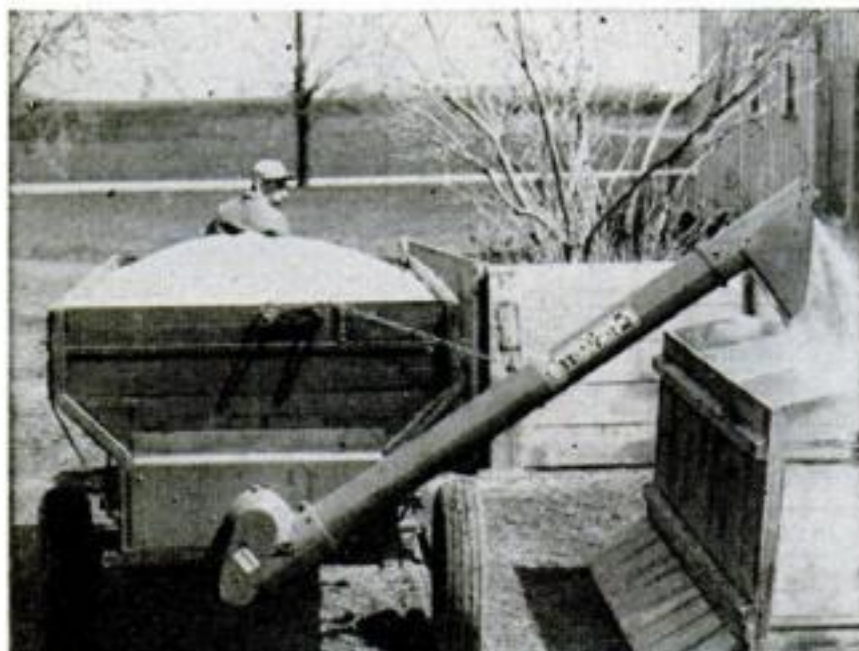
**Initials may be applied** to fountain pens and similar personal possessions with polish and masking tape. Cut the letters carefully with a razor blade, and apply two coats of lacquer.



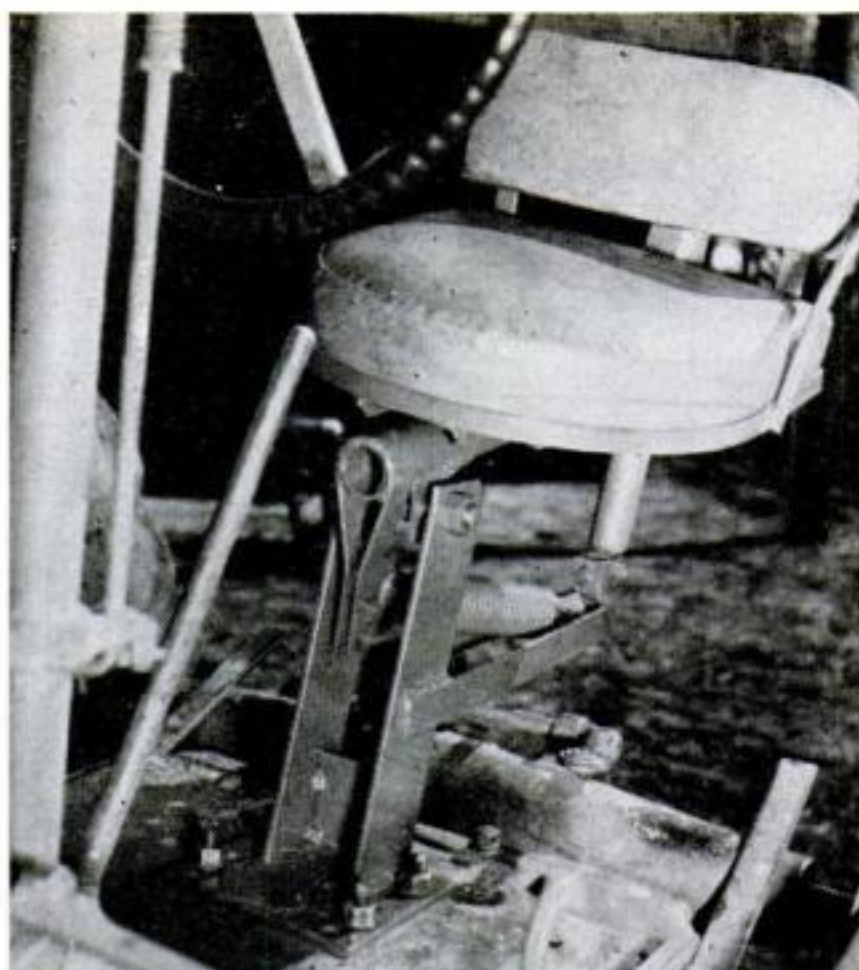
**To warn you and others** against touching high-voltage leads, mark danger points in red during installation. You can also use nail polish to identify terminals in a radio chassis.



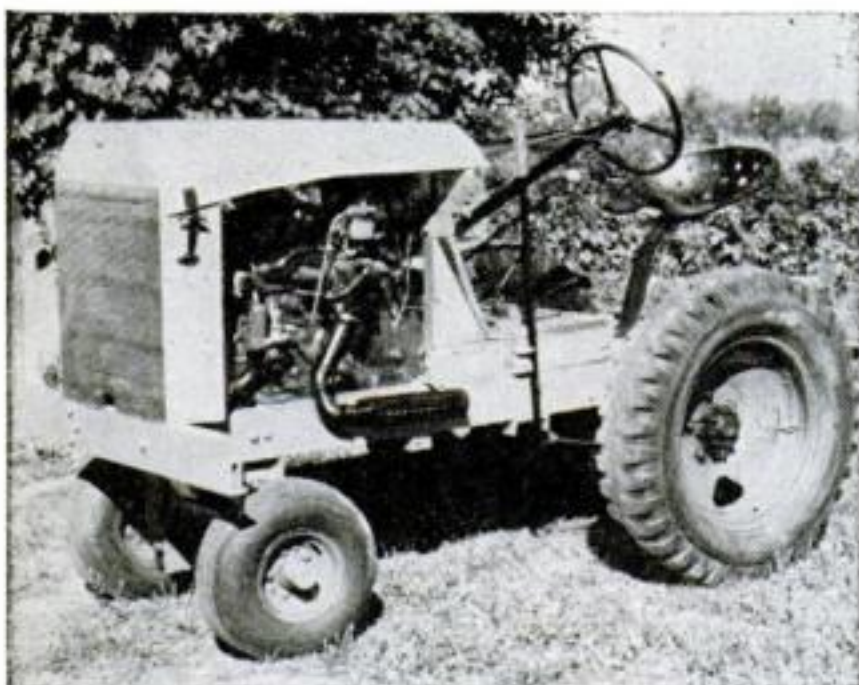
## FOR EASIER FARMING



**Grain Unloaded by Power.** Designed to fit all 38" wagon beds, an unloader made by Piper-Odell, of Princeton, Ill., includes a V-type false bottom with an auger running its entire length. A direct drive from the tractor power take-off turns this auger, which in turn drives another auger in the elevator tube. The unit is removable so the wagon may be used for other farm work.



**Seat Remains Level.** Sideways swivel action keeps this tractor seat level and the operator on an even keel on a steep hillside. In addition, a hydraulic cylinder and adjustable spring provide cushioning action in the up-and-down plane. Called the Joy Rider, the seat is a product of the Fleischer-Schmid Corporation, of Columbus, Neb. It sells for about \$10.

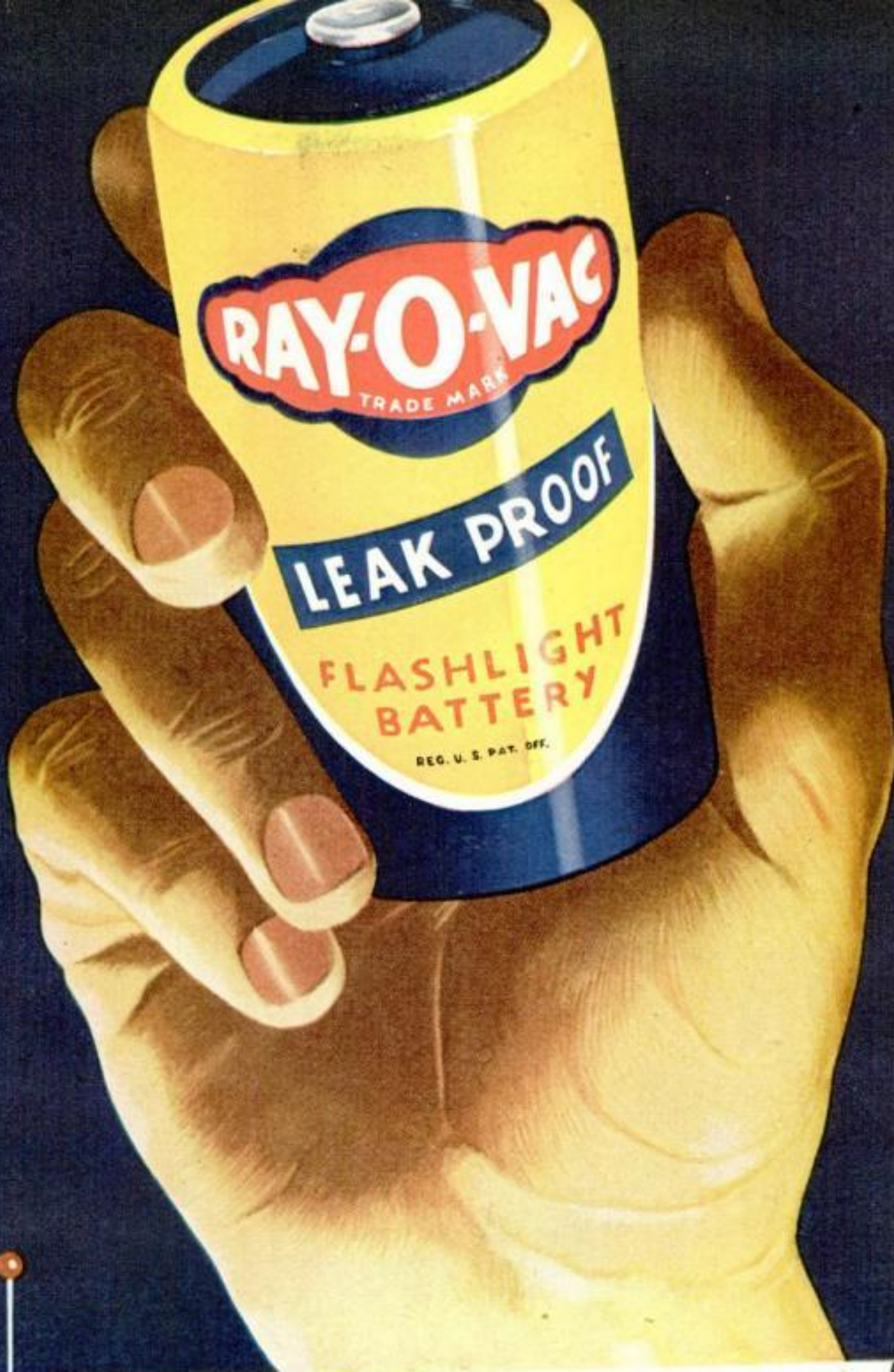


**Tractor Built at Home.** Powered by a 60-hp. Jeep engine, this 1,600-lb. tractor was designed and built by Russell Pickering and his son, of Bryan, Ohio. Built on a bolted frame of 4" and 5" channel iron, it has a standard Willys transmission with a 4-to-1 ratio, and a chain and sprocket between the transmission and drive shaft. A 1940 Ford truck rear end is also used, with hydraulic foot brakes and an individual mechanical brake for each rear wheel.



**Popcorn Pops Better.** Experimenters at Michigan State College have found that popcorn kernels must contain just a certain amount of moisture to pop satisfactorily. The correct amount can be obtained by a simple trick. For 1 lb. of popcorn, dissolve all the salt you can in 1 oz. of water. Soak up this with strips of paper toweling, scatter the strips through the popcorn, and seal in a jar for 10 days. The salt gives off or absorbs moisture as needed.





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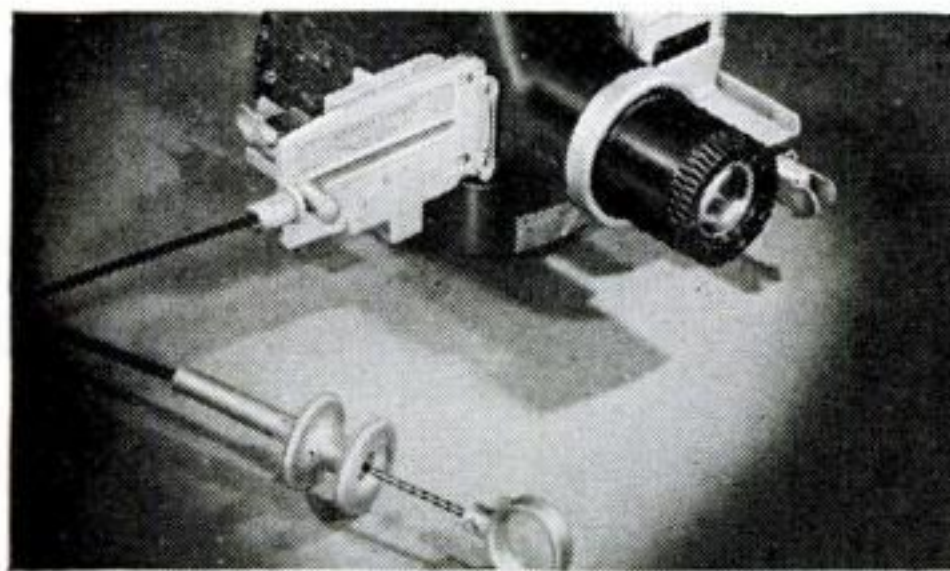
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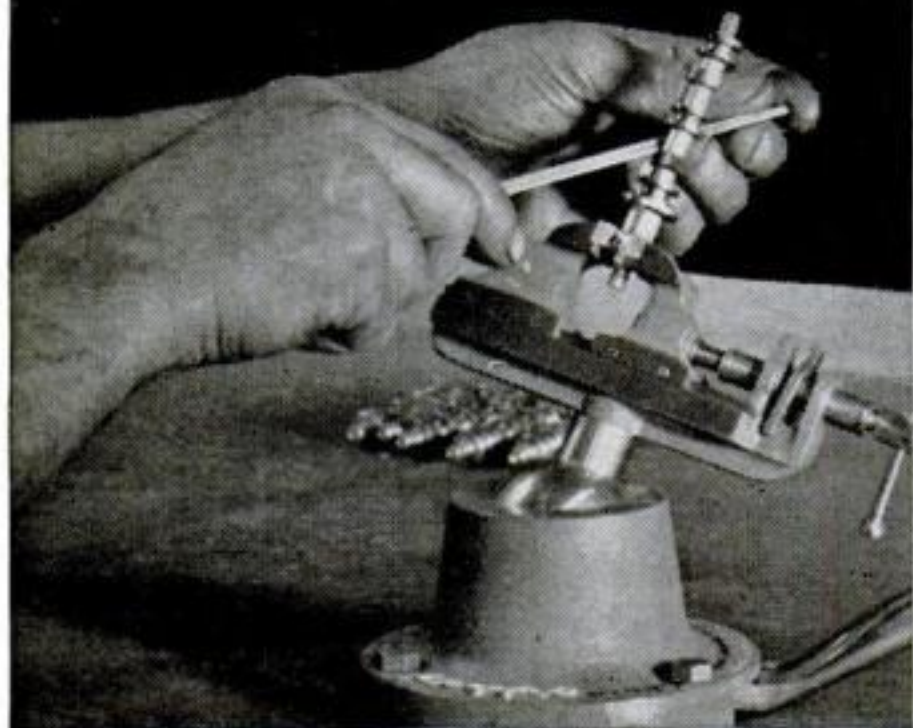
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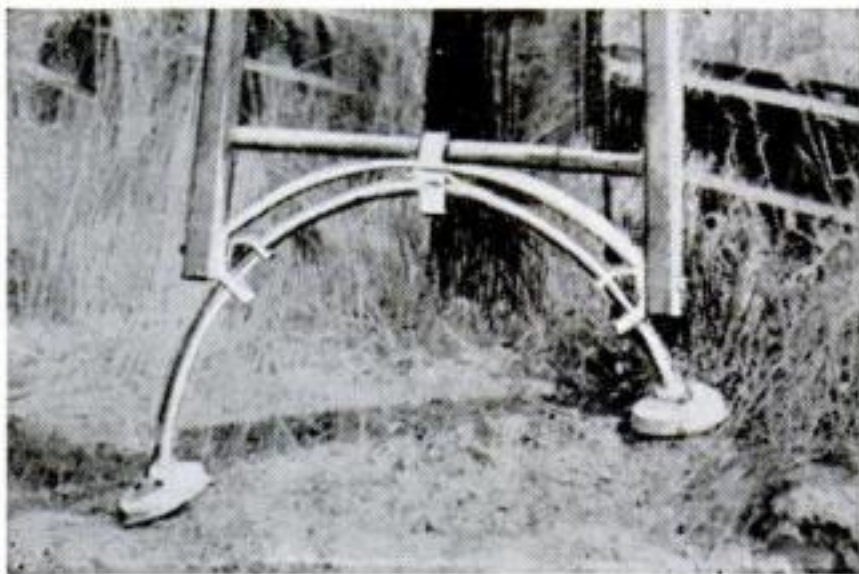
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IF THE retaining ring blows off that tire being inflated above, the man is protected by a safety cage of two-inch steel tubing designed by the Firestone Tire and Rubber Co., of Akron, O. Weighing 425 lb., the cage handles tires up to 12 by 24 inches.



### Base Levels Ladder

STEADYING a shaky ladder is easy with this attachable base, consisting of an aluminum truss joined to a steel-pipe half circle that automatically slides to level the ladder on an uneven surface. Carborundum shoes on ball-and-socket joints at the ends of the pipe assure a firm ground grip. Produced by Akron Steel and Sales, Inc., of Akron, O., the base is locked securely in place by the weight of the ladder.



Dependable

# CHAMPION

AMERICA'S FAVORITE SPARK PLUG



Dependable Champion Spark Plugs will give you sparkling performance in cider season as in every season. But the first few crisp days of Fall should be a reminder to you that your spark plugs should be serviced. If you find that new ones are needed, be sure to ask for dependable Champions—America's Favorite Spark Plug for every engine.

Champion Spark Plug Company, Toledo 1, Ohio.

***FOLLOW THE EXPERTS***

**DEMAND NEW DEPENDABLE  
CHAMPIONS FOR YOUR CAR**

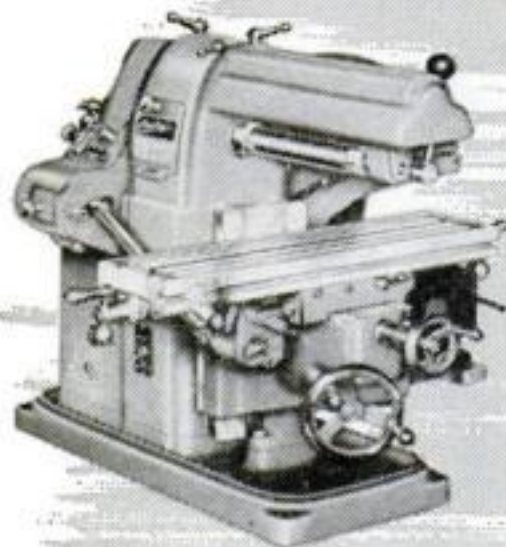
Listen to the CHAMPION ROLL CALL . . . Harry Wismer's fast sportscast every Friday night, over the ABC network

NOVEMBER 1947 229

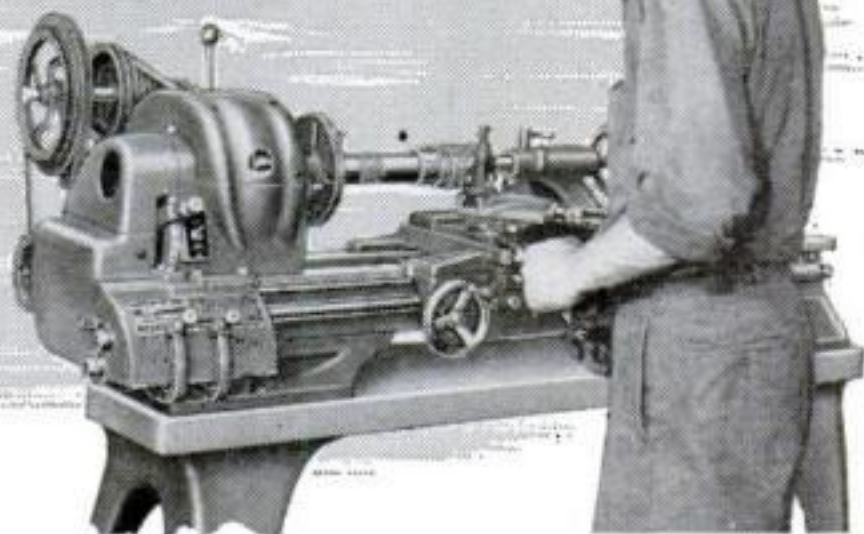


# Get Set for the **BEST SHOP** With These Fine *Atlas*

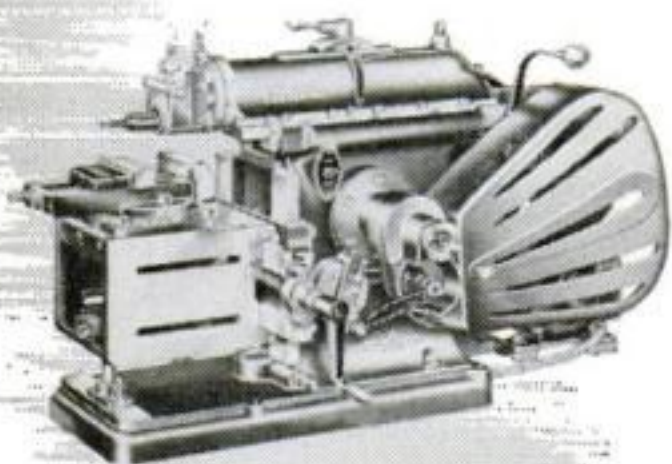
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***Atlas*** SHAPER  
\$335.00

**INDUSTRIAL PRECISION** for a home hobby shop — that's the goal of many a man. Today, it can be realized. Atlas precision metal working tools, built to industrial quality standards, will add to your shop's usefulness, save on home equipment repairs, and save on many types of home furnishings.

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If your shop interest is profit-wise — for business development — Atlas tools provide ideal research and production equipment. Whatever the products or projects you have in mind, these compact, precise tools will handle your work to perfection.

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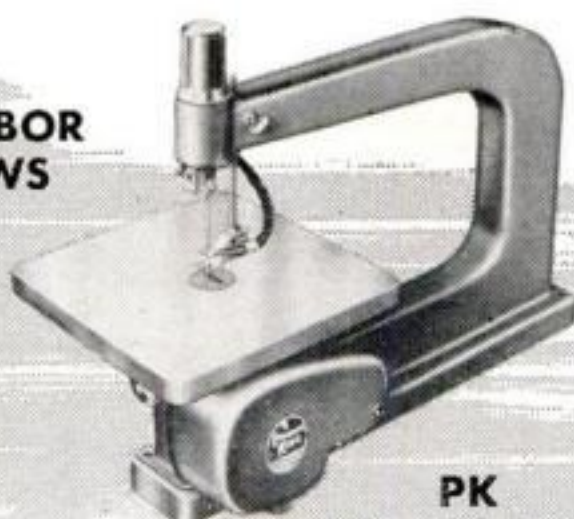
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# YEARS of YOUR LIFE! and POWER KING TOOLS



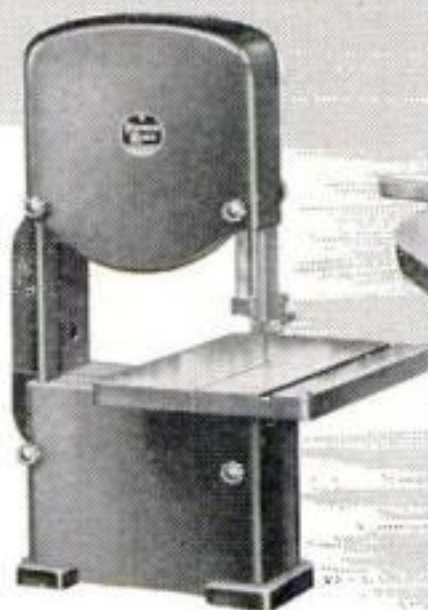
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7"-8" TILT/ARBOR  
TABLE SAWS  
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and up**



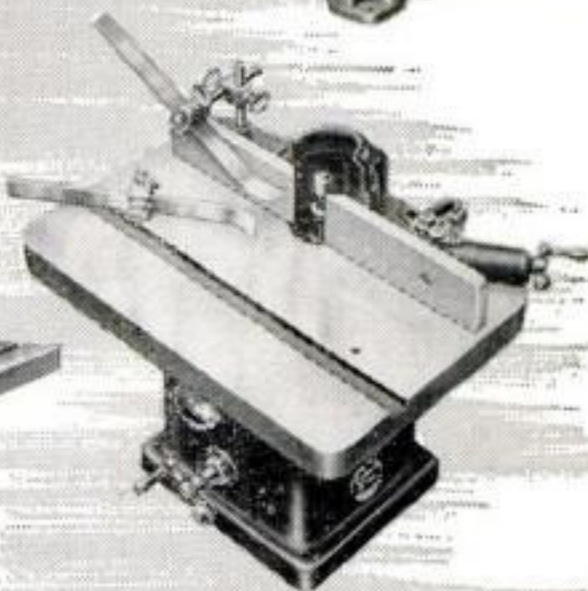
**PK  
15" JIG SAW  
\$29.75**



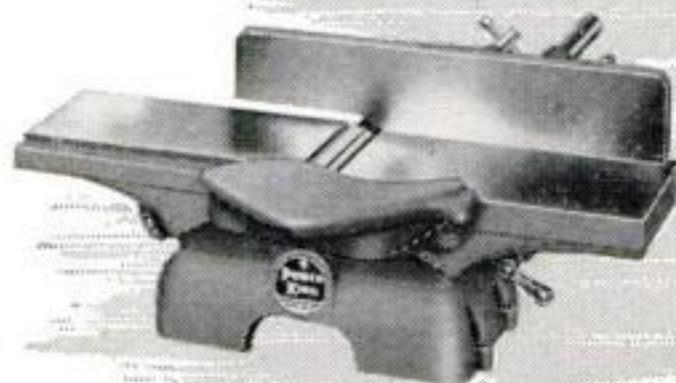
**PK  
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PRESS  
\$37.75**



**PK BAND SAW  
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NOW every home shop owner can afford to equip with power tools. Furniture, cupboards, cabinets, toys, shelves... anything in wood that you want to make... can be handled in short order, at a fraction of the cost when bought outside.

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PK tools are designed for men who enjoy their home shop as a hobby... but are practical about it, too. They give you the basic ruggedness, accuracy, and capacity you need for your various projects... yet are priced so you can equip with the full range of Power King tools within the cost formerly required for but two or three machines.

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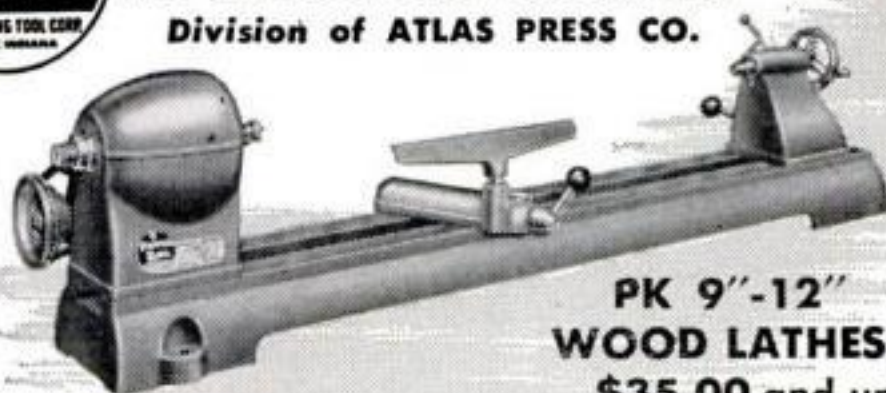
You'll quickly recognize the quality construction of Power King tools—and be proud to have them in your shop. Ask your nearest Power King dealer (name sent on request) to show you the tools that are ready for you right now.



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Division of ATLAS PRESS CO.



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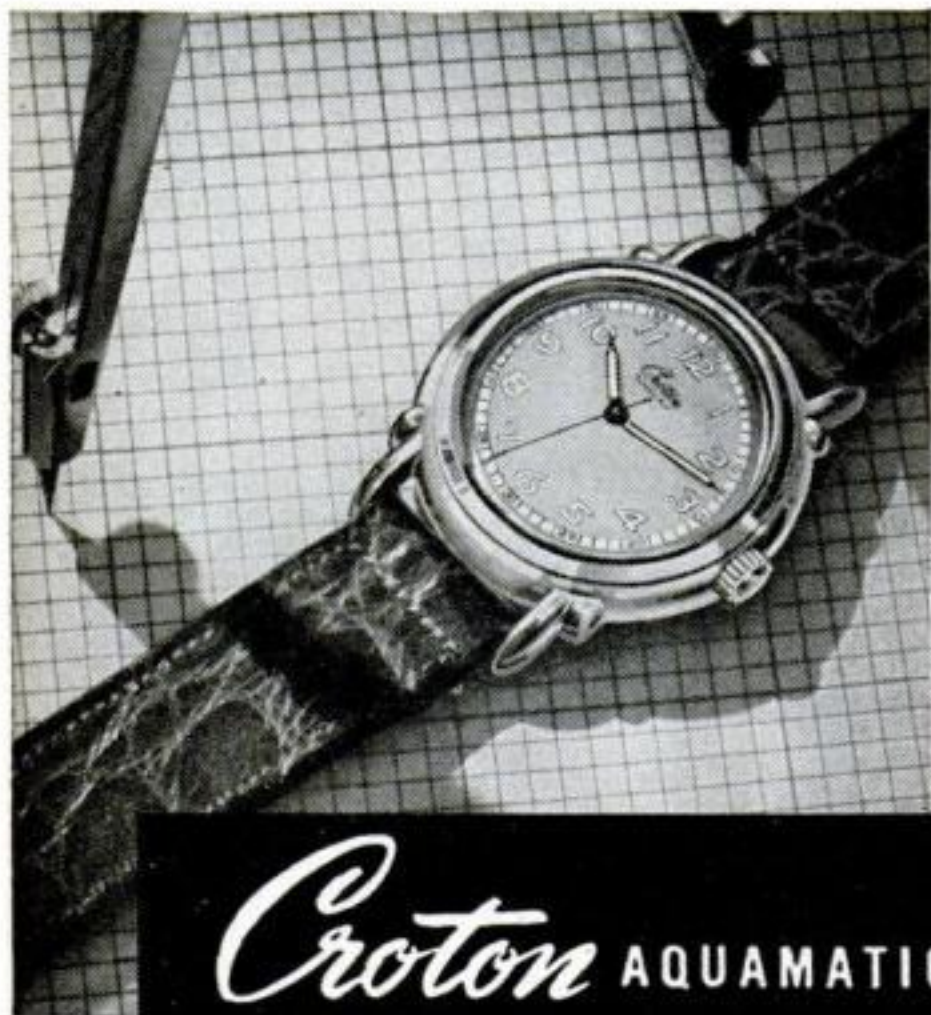
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You're always *on time* because you *don't* wind your watch! Your Croton Aquamatic keeps itself wound just right, by the ordinary motions of your wrist. It can't run down, *can't overwind*. It keeps better time — 13.5% *better time*\* than famous hand-wound watches. The Croton Aquamatic quietly and efficiently tends to its own business, while you go about yours. A wonderful idea for a wonderful gift — or for yourself. Made only by Croton — famous since 1878.



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Perfection keeps your home  
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Heater, other  
sizes available.



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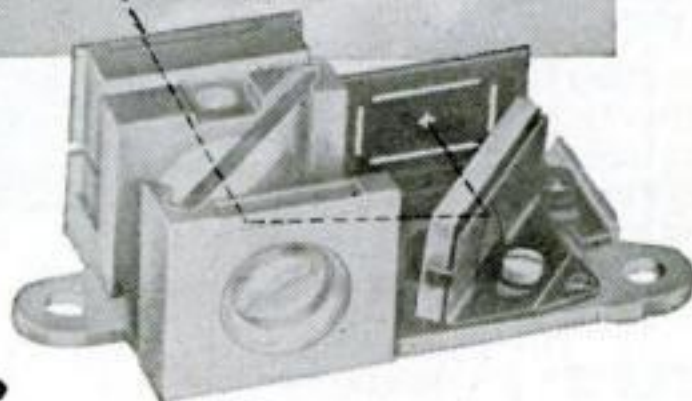
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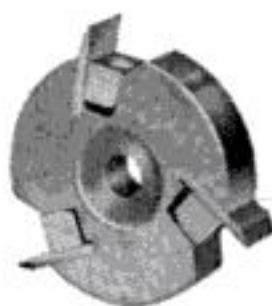
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(Including Freight)



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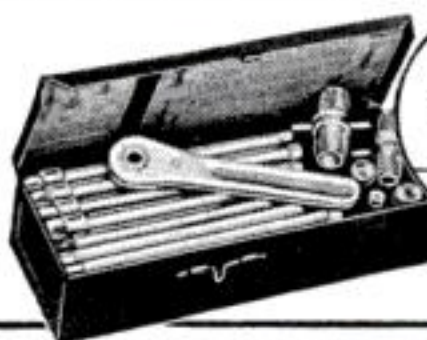
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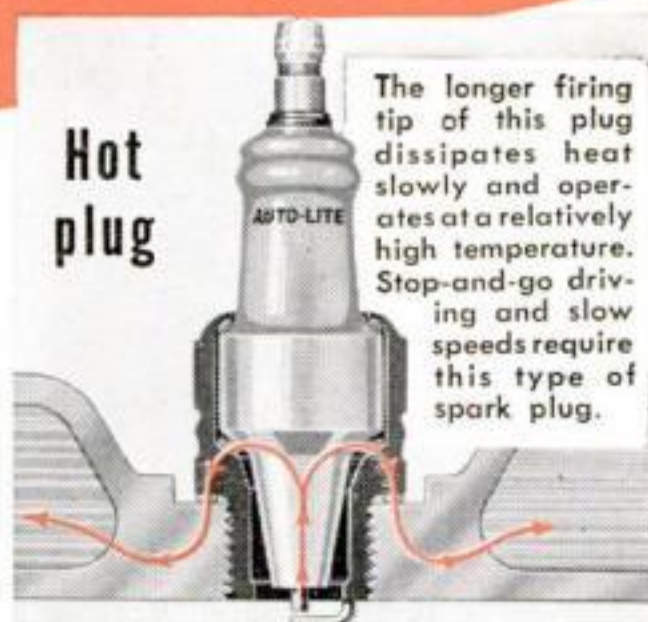
Chicago 18, Ill.





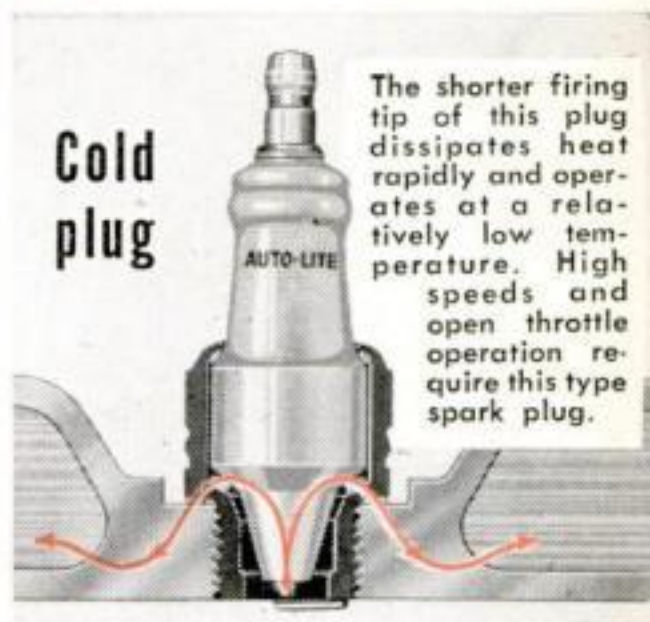
**Are your plugs wasting time and money?**

The right type of spark plug will save you time and money. Plugs which are faulty and mis-fire waste as high as 10 per cent of your fuel, according to experts. And hard-to-start engines can lose valuable time. Check all your spark plugs regularly to make sure you have the right plugs for your engines.



**Hot plug**

The longer firing tip of this plug dissipates heat slowly and operates at a relatively high temperature. Stop-and-go driving and slow speeds require this type of spark plug.



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The shorter firing tip of this plug dissipates heat rapidly and operates at a relatively low temperature. High speeds and open throttle operation require this type spark plug.

**Send for Auto-Lite "Plug-Chek" kit...only 10¢!**



**Too Hot \***

If spark plug firing tips are fused or blistered, plugs are operating too hot and may be causing loss of power and damaging spark knock.



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If spark plugs look like this, they are of correct heat range. Get your Auto-Lite "Plug-Chek" Kit right now and check your spark plugs.



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If spark plug firing tips show deposits of carbon or are wet with oil, plugs are too cold, may cause poor starting and waste dollars in costly gas.

This Auto-Lite "Plug-Chek" Kit quickly helps you find spark plugs that are causing trouble. All you do is match plugs with pictures on the "Plug-Chek" Indicator—each example refers to a page in the "Plug-Chek" Data Book that shows you what to do.



\* Because these illustrations are not in full color, they do not accurately reproduce the actual firing tip appearance. For accurate, full color reproduction, mail the coupon.



**THE ELECTRIC AUTO-LITE COMPANY**  
Department PS2, Toledo 1, Ohio

Enclosed find ten cents for the Auto-Lite "Plug-Chek" Kit that includes both the "Plug-Chek" Indicator and Data Book.

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# Ingenious New Technical Methods

To Help You  
Simplify Production



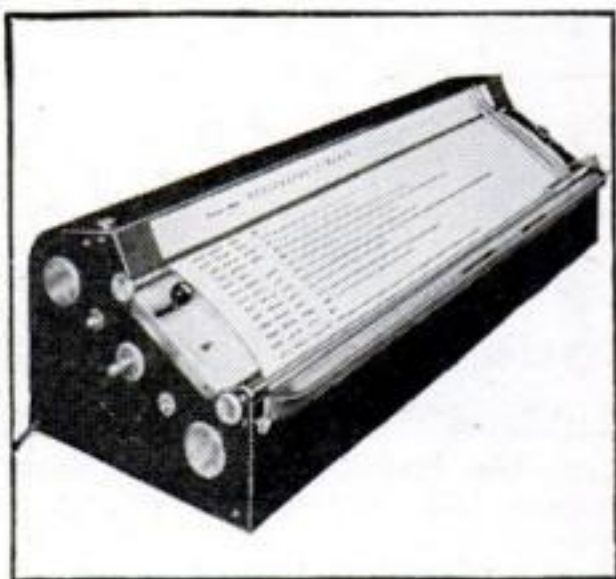
## New Automatic Device Provides Up-to-the-Minute Visual Record

The new CHART-O-MATIC provides an instant visual record of all production, shipments, purchases, absenteeism, etc. Avoids inventory surpluses. Guides purchasing department giving constant picture of all parts and supplies on hand. Requisitions can be made direct from chart. Information from all departments transmitted to operator by Telautograph permits instant recording on CHART-O-MATIC. Does away with big wall charts and card-systems and tedious, time-consuming search for data that is often far from current. With the CHART-O-MATIC, the complete activities of the entire plant can be determined in an instant.

The entire unit is easily portable and operates from 110 volts current. Chart rotates in either direction by finger-tip control. Speed may be governed by rheostat.

New devices are proving their worth in saving time and reducing nervous tension on the job. And modern plants throughout America are finding that chewing gum on the job helps relieve monotony and helps to keep workers alert. That is why more plants every day are making Wrigley's Spearmint Gum available to their employees.

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The New Chart-O-Matic



AB-78



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CLEARS!**



**OLD BLADE  
SMEARS?**

Prove that your WINDSHIELD ... like all others ... has LOW SPOTS ... hard to wipe clearly ... using ANYTHING BUT the NEW ...

## **ANCO<sup>†</sup> CLEAR-FLEX<sup>‡</sup> WINDSHIELD WIPER BLADE**

**END VIEW**



**FLEXORS**

*Pats. Pending*



### **FLEXES TO CLEAR THE LOW SPOTS**

Know CLEAR-FLEX ... the first Wiper Blade to conform fully to all windshield surface irregularities. Even wipes uniformly all types of curved windshields. Keeps clear those annoying hard-to-reach low spots common to all FLAT windshield glass. Clears quickly ... WITHOUT HELP ... blinding road muck ... slapped against your windshield ... from sloppy pavements ... by passing cars. CLEAR-FLEX already has engineering approval for original equipment on coming models of high-grade cars.

### **COSTS LESS TO USE**

CLEAR-FLEX ECONOMY REFILLS quickly MAKE LIKE NEW ... at your gas pump ... when rubber finally becomes worn or damaged. Holder OUTLASTS your CAR.

### **YOU WIN THIS WAY**

Simply ask your good gas-pump man ... next time you buy gas ... to install for you ... quickly ... out on the driver's half of your windshield ... one ANCO Clear-Flex Wiper Blade.\* Deposit with him only the regular price ... printed on its box. Keep your old Blade ... if you like.

### **THE CONTRAST TELLS**

Leave untouched the used Blade and Arm on your OTHER wiper shaft ... until you compare it with CLEAR-FLEX performance ... in the next storm! You are delightfully amazed ... by CLEAR-FLEX. Eye-strain ... jangled nerves ... FILM FATIGUE ... GONE! You enjoy at last the relaxed comfort ... and added safety ... of crystal-clear driving vision.

### **YOUR MONEY BACK QUICKLY —IF YOU'LL TAKE IT!**

If you then are willing to part with your ANCO Clear-Flex Blade ... the dealer who put it on for you is authorized by us to remove it ... put back your old Blade ... and refund pleasantly every cent you deposited for CLEAR-FLEX. We protect him in that. Show him this ad. You risk no money. Get yours today. Try it. Then make it a PAIR. May save you a costly smashup!

### **ANCO DEAD-LOCKER WIPER ARMS**



\*—Use CLEAR-FLEX Blade ONLY with the sturdy ANCO Dead-Locker Arm ... already on millions of cars. ANCO Arm fits quickly any wiper shaft. Suits any good wiper motor. Holds Blade true ... at correct pressure. If not now on your car, ask serviceman to install a PAIR quickly for you. More than 250,000 good gas stations and service stores sell ANCO BETTER Blades and Arms.

Made by the makers of long-famous ANCO RAIN-MASTER<sup>†</sup> Blades and Arms ... original equipment for years on DeLuxe models of high-grade cars. Your dealer knows ANCO.

<sup>†</sup>Trade Mark Reg. U. S. Pat. Off.

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**Established 1918  
GARY, INDIANA**



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**HEART**  
OF YOUR FUEL  
SYSTEM



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Pulsing steadily, hundreds of times a mile, your AC Fuel Pump is the strong, reliable heart of your fuel system. It has given you long, faithful service because of its inbuilt quality and scientific design.

You can prolong that faithful service indefinitely, if you insist upon an AC when you replace your present pump with a new or rebuilt one.

AC SPARK PLUG DIVISION • GENERAL MOTORS CORPORATION

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← YOUR MOTOR

**NOW! For Only \$5<sup>95</sup> You  
can have an Amazing New  
FLEXIBLE SHAFT TOOL**

with PENCIL-SIZE HANDPIECE

**Grinds, Polishes, Sharpens, Cleans, Mills, Carves,  
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Now you can turn your old motor, drill press, or electric drill into a Flexible Shaft Tool. Amazing new Presto-flex, latest addition to the Foredom flexible shaft family. Simply attach to your electric drill, drill press or motor. Presto—a flexible shaft machine! Off again in a jiffy! Pencil size handpiece gives you finger-tip control. Gets into tight places you can't reach with any other tool. Handy 35" overall length. And—only \$5.95 complete! Order NOW.

—SEND NO MONEY—

Just send your name and address. We will rush your Presto-flex COD. Pay postman \$5.95 plus postage or send \$5.95 now and WE pay postage. Money back if not delighted! If you order Presto-flex for use on motor, specify motor shaft diameter and add 50c for motor coupling. (Available for 1/4", 5/16", 3/8" and 1/2" shafts.) 50 piece accessory set available \$1.50 extra. Order TODAY from

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Dept. 135

Manufacturers of Flexible Shaft Equipment for Home  
and Industry For a Quarter-Century.

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110 v. AC—Heavy Duty  
CONSTRUCTION

Fractional H.P. ball bearing  
New—Ideal for power tools,  
fans, models, etc.

Prices F.O.B., N.Y.C.

Remit 20% Bal. C.O.D.

**\$4<sup>95</sup>**



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NEW YORK 7, N. Y.

## U. S. NAVY 7x50

PRISM

### BINOCULARS

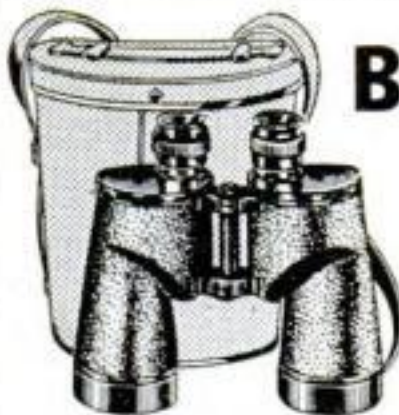
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EXCELLENT CONDITION

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Complete with leather  
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Engineers All Metal Army Type Hand-Sighting

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Send \$1.25 for 3rd Edition of Gun Digest with our complete catalog of new and used guns, etc. Our separate catalog 25c.

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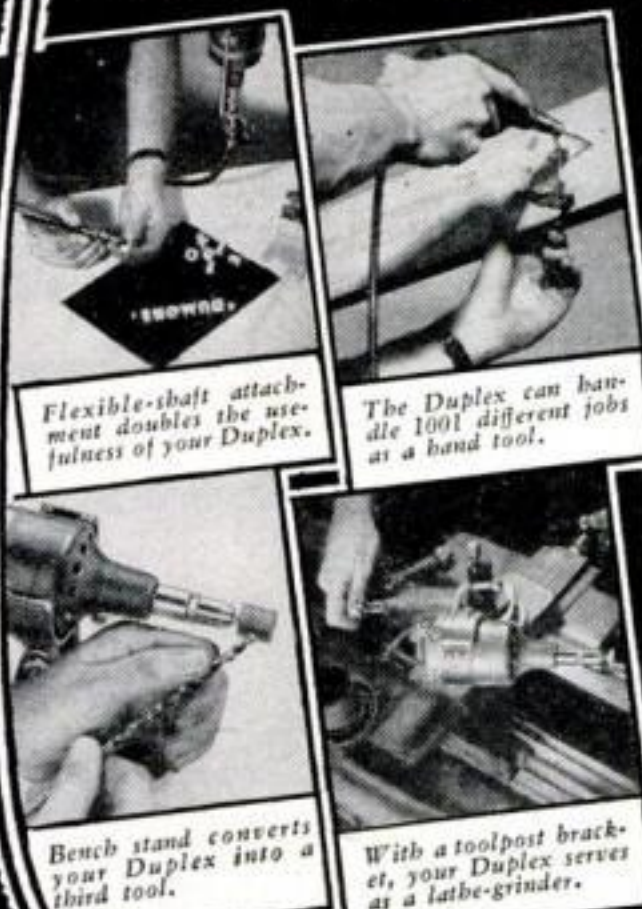
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# The Sensational New Dumore Duplex

makes your work easier, faster and twice the fun!



Flexible-shaft attachment doubles the usefulness of your Duplex.

The Duplex can handle 1001 different jobs as a hand tool.

Bench stand converts your Duplex into a third tool.

With a toolpost bracket, your Duplex serves as a lathe-grinder.

If you want a good handgrinder — get a Dumore!

Here's the handgrinder you've always wanted for your workshop—the tool that gives you *more* of everything you want, than any other handgrinder. Its full 1/14 HP motor has the extra power for "heavy" jobs. Its extra-capacity chuck takes all 3 tool sizes—1/4", 1/8", 3/32".

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Think what you can do with the

extra power, capacity, and versatility of the Dumore Duplex! Work in wood, metal, and plastics is faster, easier—and twice the fun! And the Duplex costs no more than an ordinary handgrinder: 27-accessory Deluxe Kit—\$27.50; 9-accessory Standard Kit—\$19.75; flexible shaft and other attachments extra.

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**Satisfaction guaranteed — or your money back in 10 days!**

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H-7



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Every home craftsman wants to work metal. Now he can . . . without buying large, expensive equipment. The new TRU-TURN TOOL converts drill presses, grinder stands and woodturning lathes into PRECISION metal lathes. TRU-TURN has a built-in micrometer . . . is suitable for commercial shops. Beginners can produce work with a high-grade finish immediately. Turns and cuts-off steel, brass, aluminum.

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## AIRCOOLED DIESEL POWERED GENERATING SET . . .

Generating sets  
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Power units to  
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This 2,000 watt Sheppard unit delivers steady, dependable current for about 1¢ per K.W. hour. Powered by an aircooled Sheppard diesel, it operates on low-cost domestic furnace oil.

It's the ideal power source for water systems, refrigerators and home-lighting . . . or wherever economy is important without sacrificing dependability. Write for complete information—see how a Sheppard Diesel Generating set saves as it serves.

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The famous BERNARD Parallel Action Plier (#102), the plier with the "wonderful head on its shoulders". Serves as plier, wrench, cutter and glass breaker. One ton bite at cutter.



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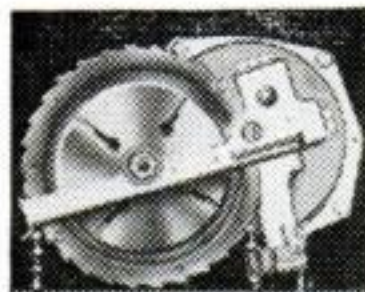
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Easily lifts or pulls up to 350 pounds. 20 ft. of multi-strand wire rope can be fed out of any one of three drum housing openings.

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THE AMAZING ELECTRIC SCROLL SAW



7,200 Strokes Per Minute  
**JUST GUIDE IT**

Only  
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COMPLETE  
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**AVERAGE CUTTING SPEED  
ONE FOOT PER MINUTE**

Boys from 8 to 80 (and girls, too) have fun with a Moto-Saw . . . it works more like magic than any tool you ever saw! Takes no effort to run, no perceptible pressure to feed . . . only a trifle heavier than a hand scroll saw, and better balanced in your hand. Runs 7,200 strokes a minute . . . leaves no rough edges . . . easily cuts intricate scroll designs in medium-hard wood up to  $\frac{3}{4}$ " thick. Blade holder faces blade 4 ways . . . permits sawing sideways as well as forward and backward. No limit to length of stock it will cut . . . saws to center of 19" widths. Plug into any 110-120 Volt, 50 or 60 cycle alternating current outlet (does not operate on direct current). See Dremel Moto-Saw at your dealer's. If he cannot supply you, use coupon below to order on 10 day, money-back trial.

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The versatile Moto-Saw is as safe as a hand saw . . . a touch of the trigger switch sets it going . . . releasing stops it instantly. A thrill awaits you when you first feel the hang of Moto-Saw in your hand and sense its surge of precision power. Sturdily constructed . . . only two moving parts . . . never needs oiling . . . requires no bench room or floor space. Thousands of satisfied users.

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"THE POCKET-SIZE  
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Look at the rest . . . then buy the best! Only Moto-Tool offers about 27,000 R.P.M. (the speed necessary to conserve cutters, do fine work). Owners declare Moto-Tool the handiest tool in the home or shop . . . find new uses for it daily.



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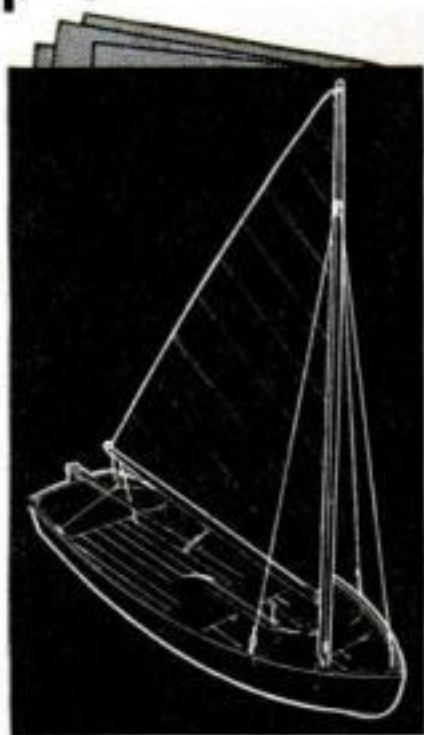
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The "Sea Pup" is the first in a new series of boat plans, designed exclusively for Casco-phen by William F. Crosby, creator of the famous "Snipe" and "Seagull."

She can be rowed, sailed, or powered with a light outboard. She's 12' long, 4'5 1/2" beam, seats 2 to 4.

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Plans for the "Sea Pup" retail at only \$2.50 a set and consist of 5 easy-to-read 24" x 30" blueprints. They include: Complete bill of materials and specifications for hull, hardware, rigging and fasteners... all lines and offsets, profiles and sections, construction plans and detail drawings.

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Mr. ReQua has reason to like his Handy iron. For it has same design as G-E industrial irons, yet is lightweight, easy to use, built to last. See the G-E Handy iron at your dealer's today. If your dealer does not have them order direct, giving us your dealer's name. Department 667-4, Apparatus Department, General Electric Co., Schenectady, N. Y. George ReQua, Free: "How to solder" manual hobbyist and home craftsman.

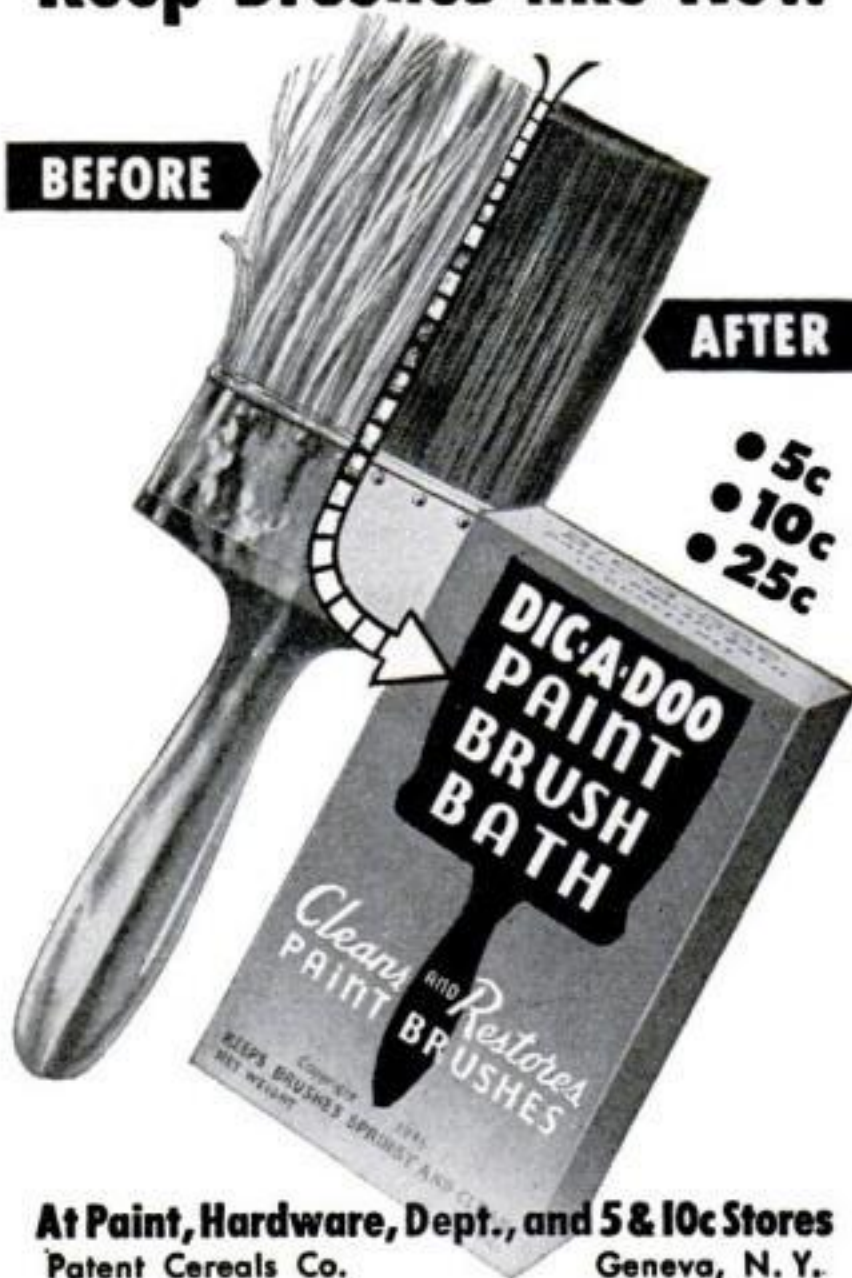


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A practical, economy-priced drill press built specifically for the hobbyist . . .

**Only \$39<sup>95</sup>**  
for this  
**HOMECRAFT®**  
**11-inch**  
**Drill Press**  
(Motor extra)

**Fulfills the long-standing need for a good, popular-priced tool that adequately meets the basic requirements of the home woodworker**

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With this versatile tool, you do many jobs safely, accurately, and inexpensively. You can even drill ½-inch holes in cast iron. Four speeds provide a wide range from 700 r.p.m. to 4700 r.p.m.

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#### A Real Value

In the moderate-priced Homecraft 11-inch Drill Press — intended solely for the hobby shop — Delta

gives you as fine a tool as can possibly be built for the money! Look at some of the features that are included:

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These are reasons why you enjoy a sense of pride and satisfaction working with your good-looking, efficient Homecraft 11-inch Drill Press.

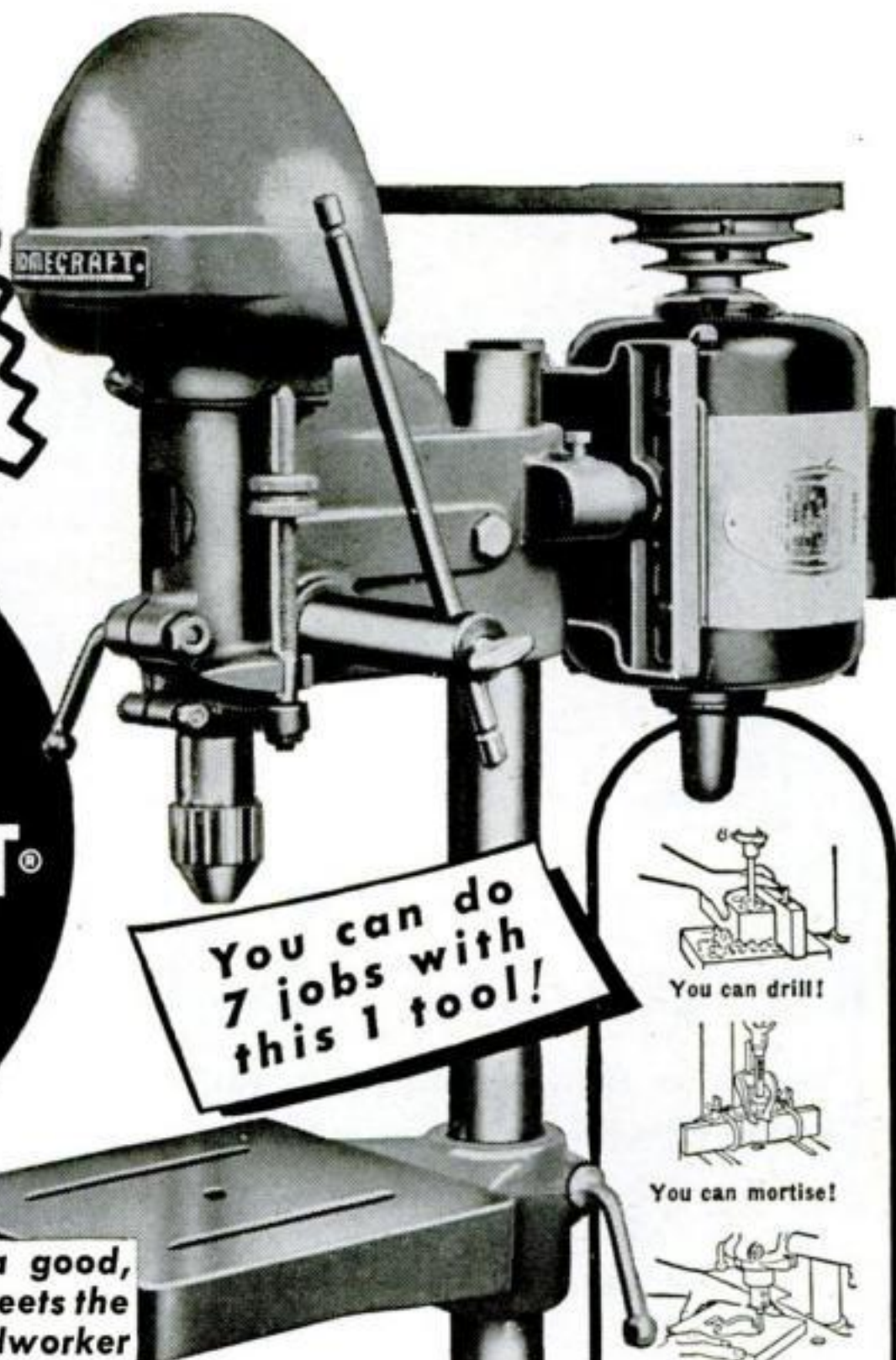
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Ask your Homecraft dealer to show you this new drill press, and his complete display of Homecraft Power Tools that range in price from \$29.95 to \$39.95.

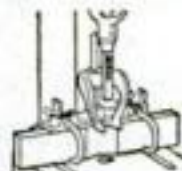
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## KEEPS NEW CARS... NEW LOOKING

## Completely New and COMPLETE

### Federal's Low Price INCLUDES A Highly Corrected Enlarging Lens

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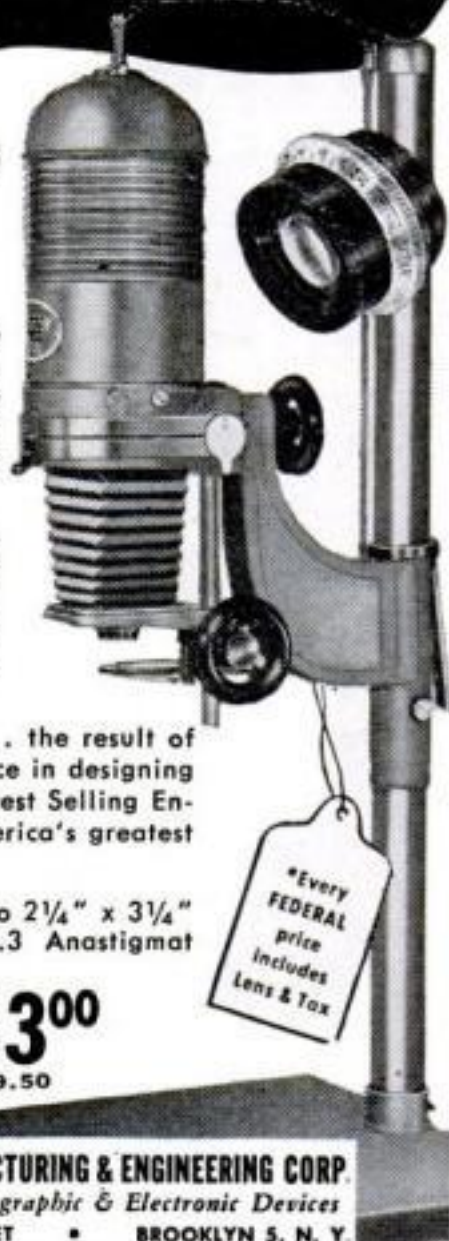
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A new type air cooled motor that has 3 times the power of the pre-war model. Protected self-aligning, oil impregnated bronze bearings. A new 1-piece die cast aluminum housing with integral wheel guards and tool rests. Built in switch, rubber covered cord and plug. 1 coarse wheel, 1 fine wheel (4½"x3½"x3½"). You can never appreciate the sweet running balance and grinding efficiency of this grinder until you test it. Ask your SpeedWay dealer to demonstrate.

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SpeedWay Blue Line Tools are built for use. Each operates at the correct speed for its capacity and operation: Grinders grind at the proper speed to give efficient f.p.m. without excessive wheel wear; drills drill at speeds that cut rapidly thru work but won't burn drill bits . . . or with one of the stands illustrated, quickly convert into a sturdy, inexpensive, lever-operated drill press.

Each has its own specially wound, high torque, long life, air cooled SpeedWay tool motor, and all embody the quality features and "tool sense" developed thru SpeedWay's 35 years of specialization in the design and manufacture of portable electric tools.

Standardize on SpeedWay Tools. You will not only have better tools but in each case more tool for the money.

Sold by hardware, farm implement tool dealers, and tool departments everywhere . . . by many household appliance outlets and electrical stores.



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Drill Stand  
(Less Drill)  
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½" ELECTRIC  
DRILL **\$2995**



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AT A GLANCE

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CALENDAR  
WATCH

Tells time, name of day and date.  
Day name changes automatically.

No. LN 383 — 17 jewels, water-shock resistant, anti-magnetic, radium dial and hands. ALL STAINLESS STEEL CASE..... **\$55.00**

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One of the Army's best. Ideal for amateur use, covers 80 meter band, 25 watt, crystal controlled, supplied brand new with meters, tuning unit, speech amplifier, and modulator. Less tubes. Shipping weight, 80 lbs.



**\$12.95**

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Consists of electric motor operating generator on same shaft. Many applications — operating radios from storage battery — using as motor.

Dynamotor A—Input 12 volts, output 1000 volts at 350 MA. Shipping weight, 72 lbs. **\$7.95**

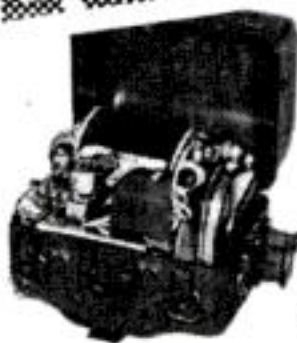
Dynamotor B—Input 6 or 12 volts, output 350 volts, 160 MA. Shipping weight, 30 lbs. **\$5.95**

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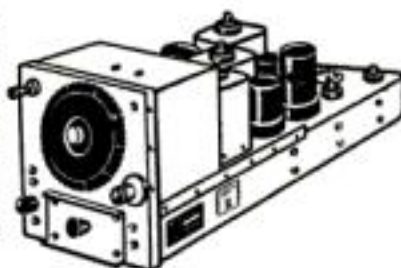
## MINIATURE HEADPHONES

Miniature type headphones. Ideal for hearing aids, listening to radio in bed, etc. Complete with headband, cord and two sets rubber ear plugs. Shipping weight, 1 1/2 lbs. **ONLY \$1.00**



## BC455B AIRCRAFT RECEIVER

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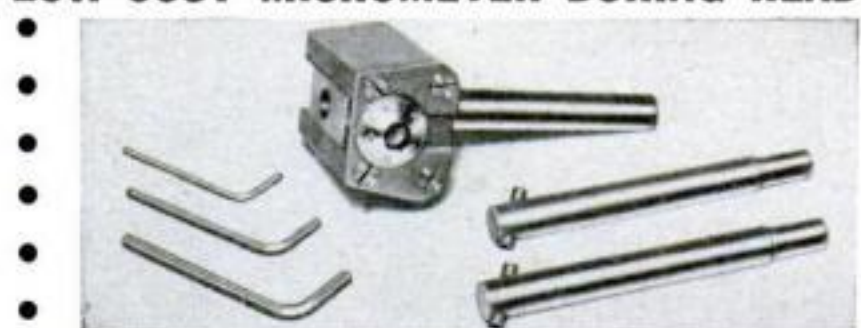
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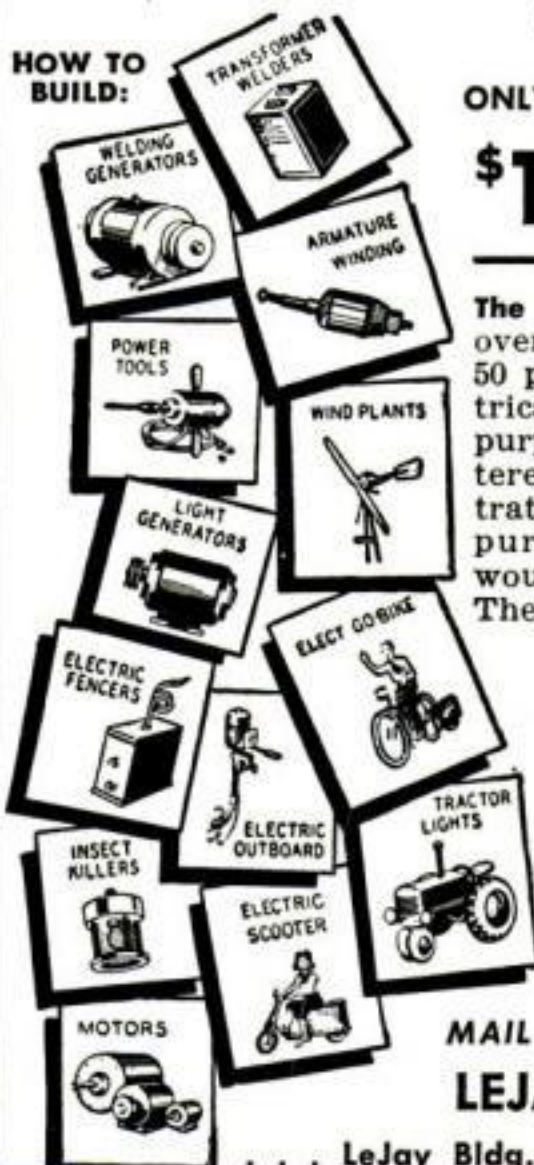
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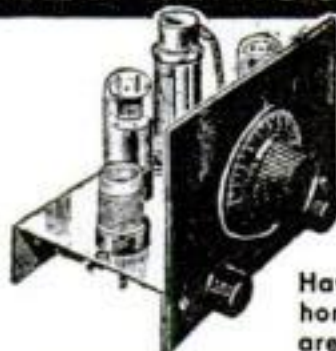
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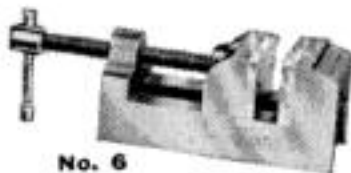
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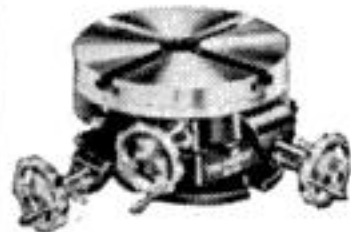
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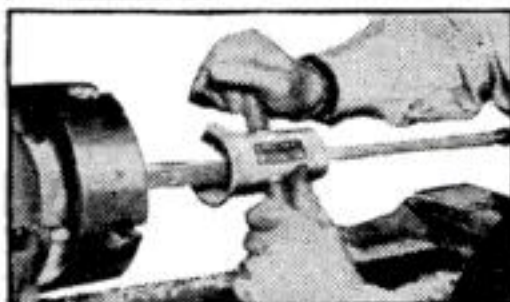


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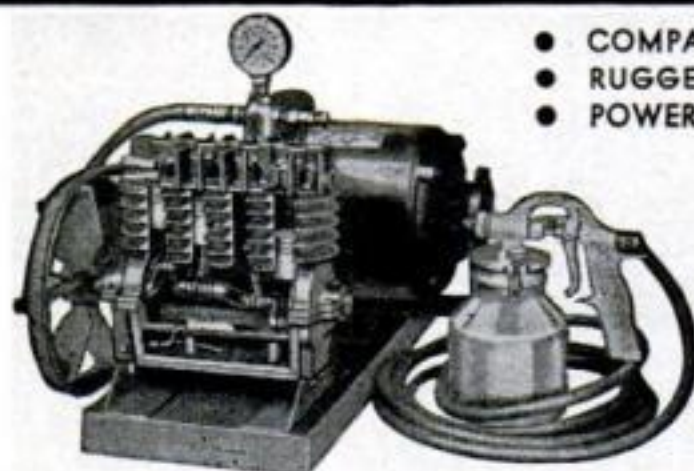
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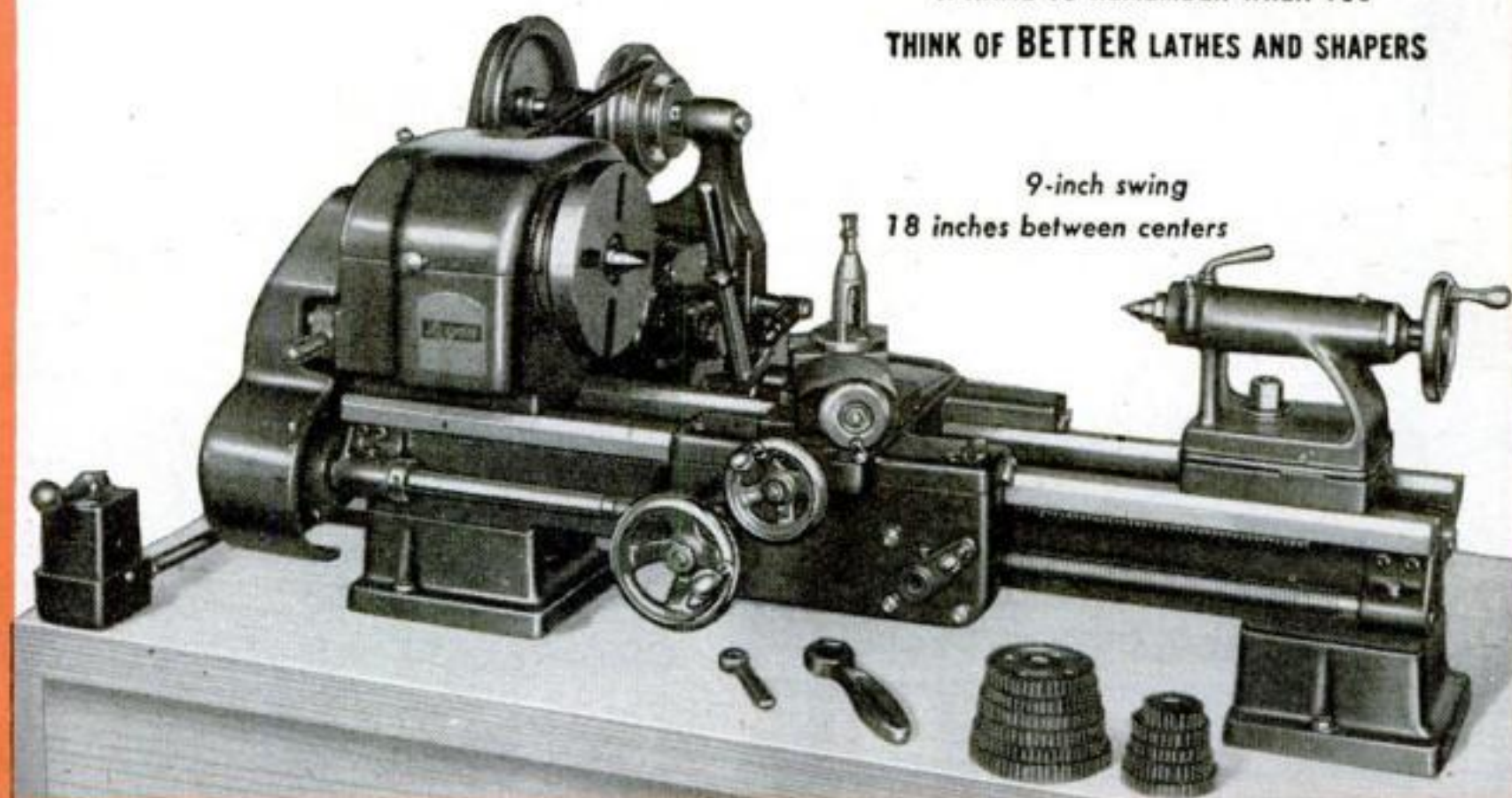
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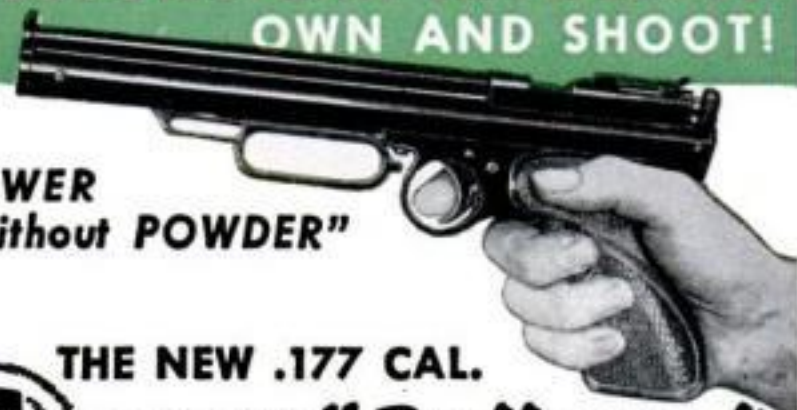
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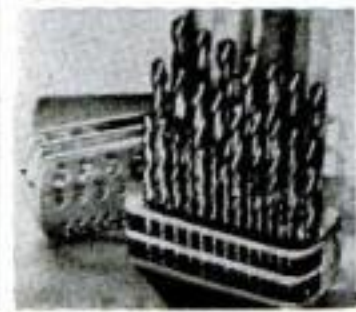
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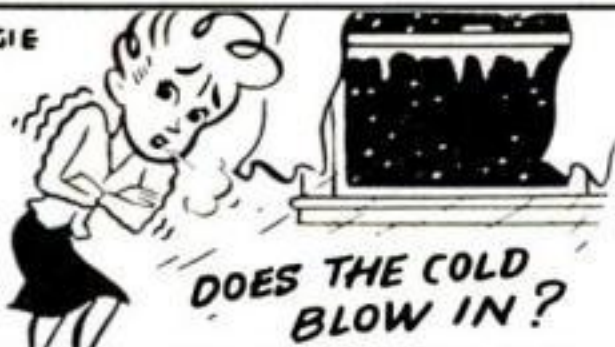
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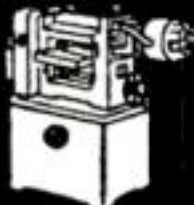
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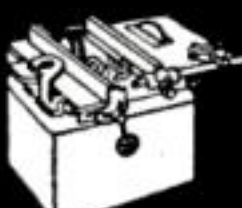
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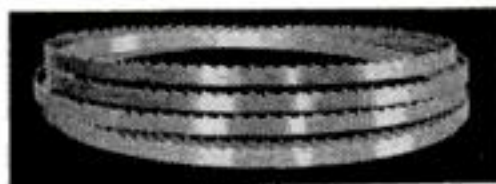
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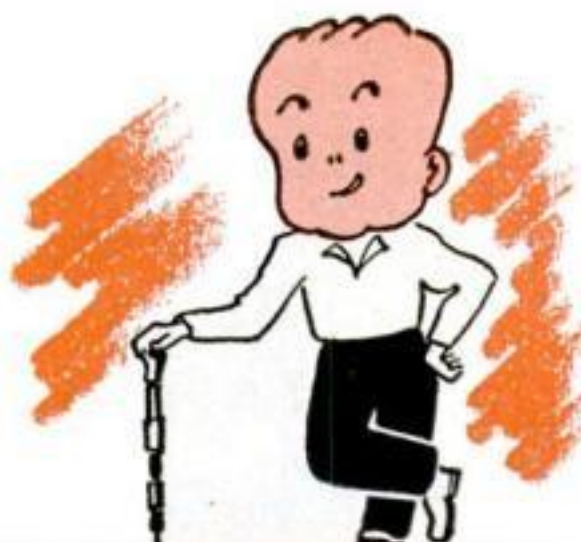
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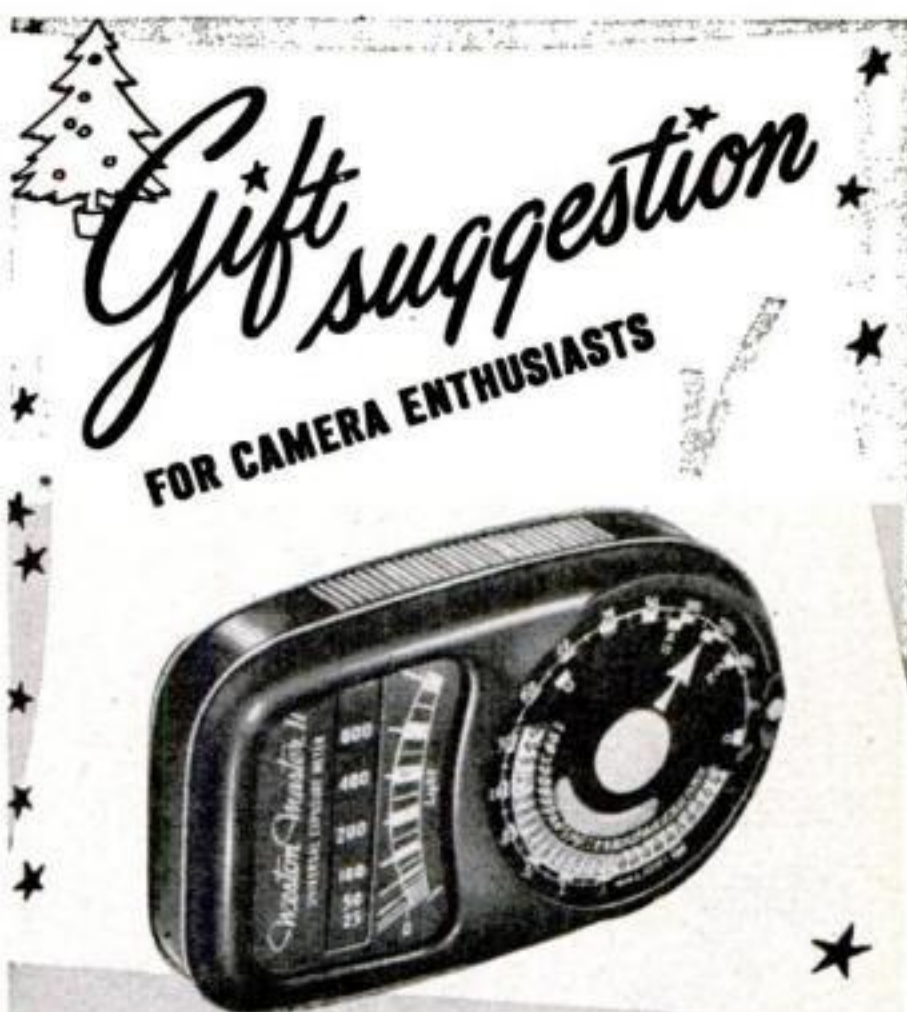


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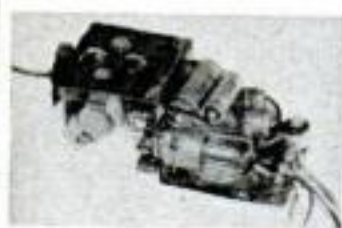
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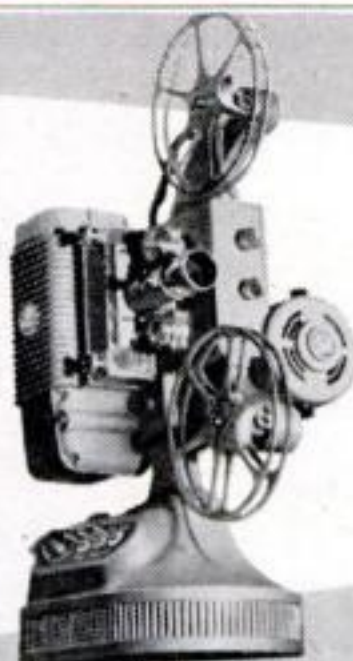
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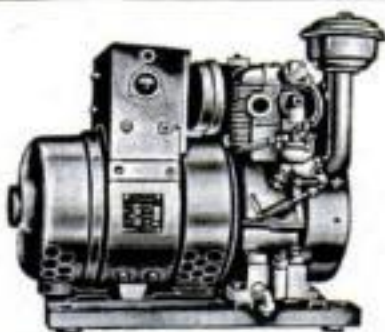
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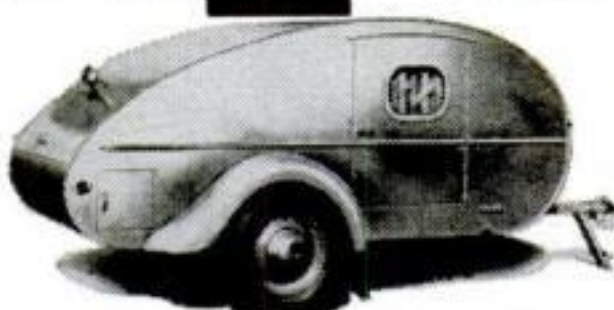
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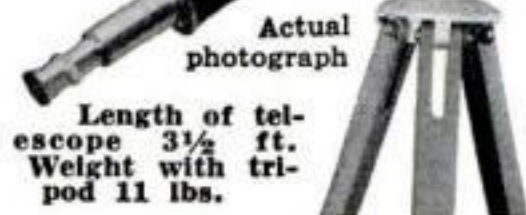
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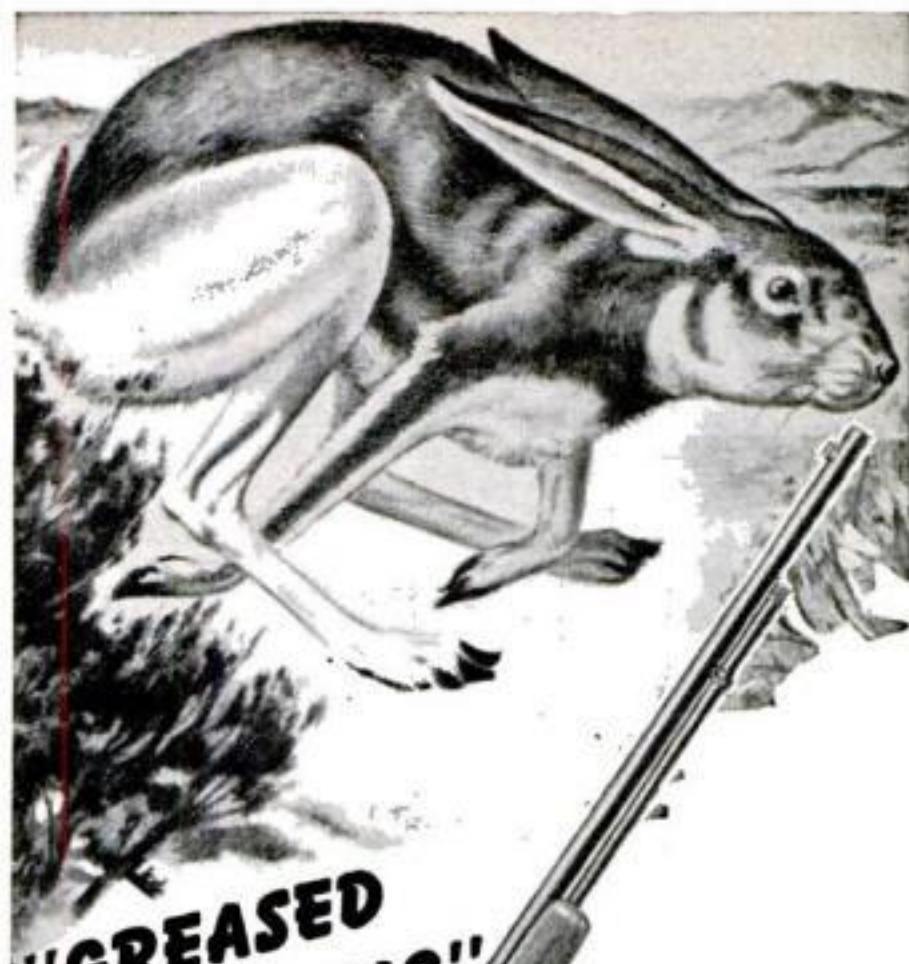
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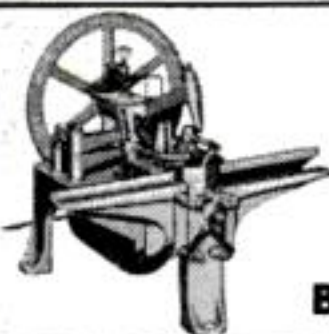
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SAWS



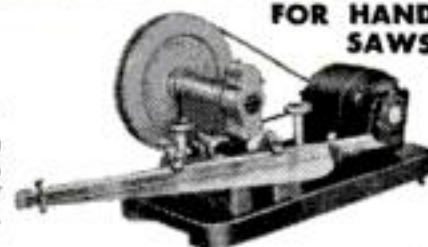
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NUMBER 2000

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SAFEST!

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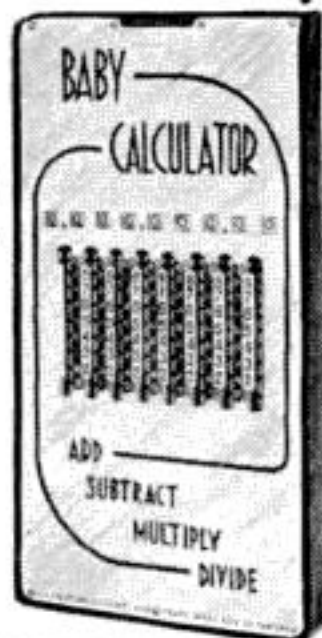
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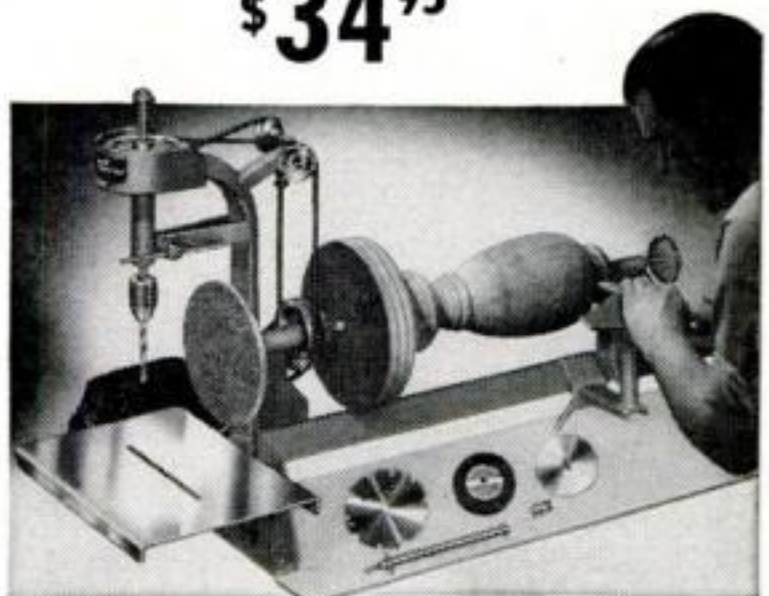
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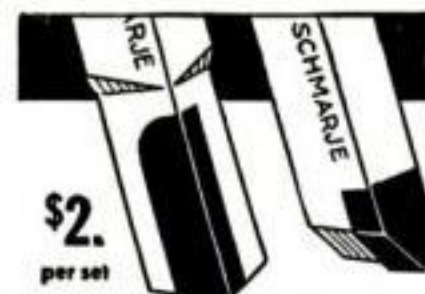
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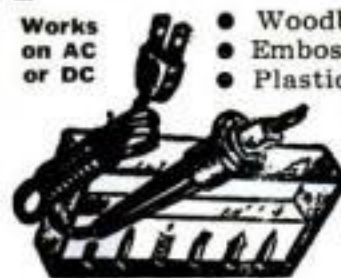
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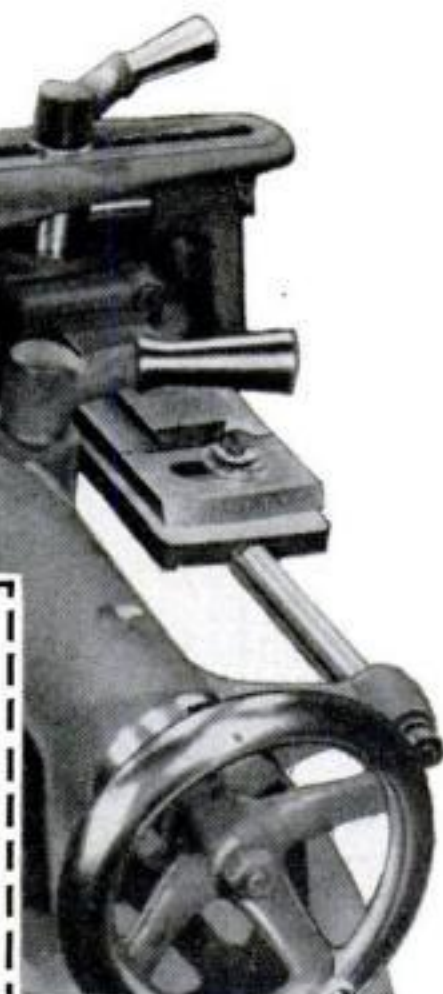
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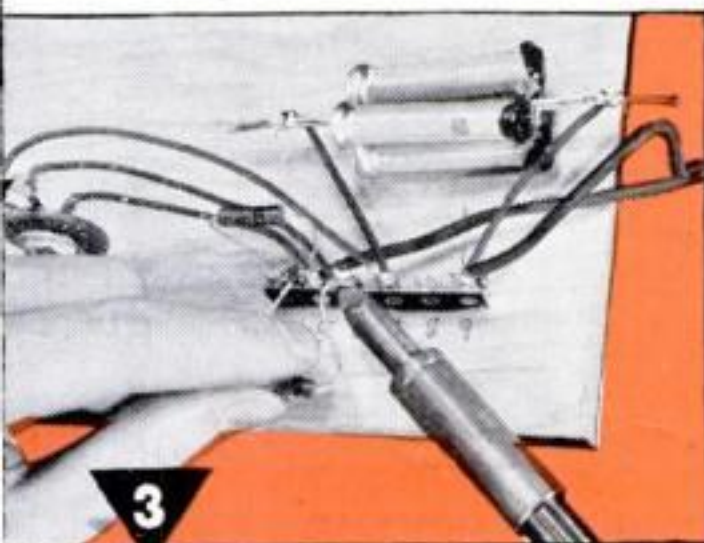
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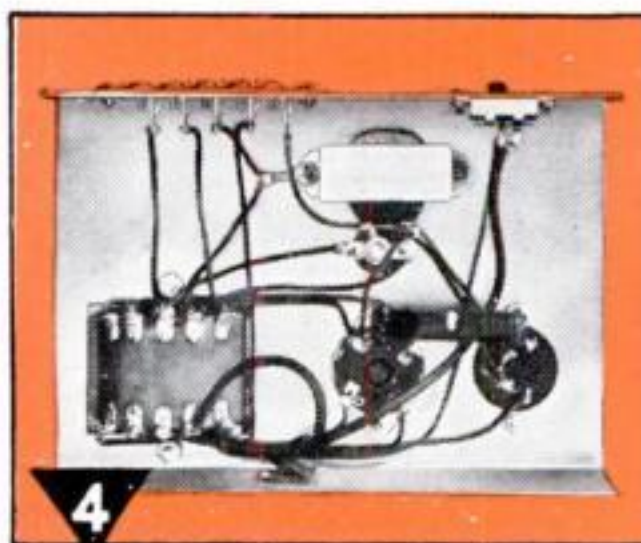
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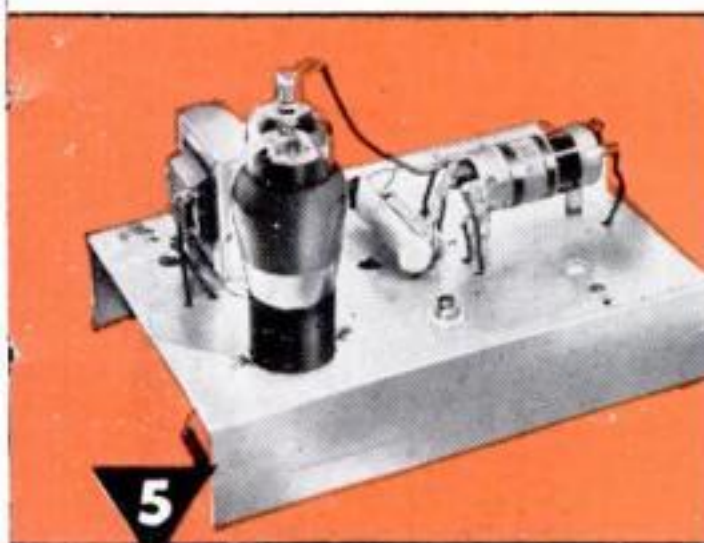
# Learn RADIO by PRACTICING in



**3** You get parts to build Radio Circuits; then test them; see how they work; learn how to design special circuits; how to locate and repair circuit defects.



**4** You get parts to build this Vacuum Tube Power Pack, make changes which give you experience with packs of many kinds; learn to correct power pack troubles.



**5** Building this A. M. Signal Generator gives you more valuable experience. It provides amplitude-modulated signals for many tests and experiments.



**6** You build this Superheterodyne Receiver which brings in local and distant stations—and gives you more experience to help you win success in Radio.

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Do you want a good-pay job in the fast-growing Radio Industry—or your own Radio Shop? Mail post card at right for a Sample Lesson and my 64-page book, "How to Be a Success in RADIO," both FREE. See how I will train you at home—how you get practical Radio experience building, testing Radio circuits with BIG KITS OF PARTS I send.

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The day you enroll I start sending EXTRA MONEY manuals that show you how to make EXTRA money fixing neighbors' Radios in spare time while still learning! It's probably easier to get started in Radio now than ever before, because the Radio Repair Business is booming. Think of even greater opportunities as Television, FM, and Electronic devices become available to the public! Cut out and mail post card for FREE books now!

Mail post card for Sample Lesson and FREE 64-page book. Read details about my Course; letters from men I trained; see how quickly, easily you can get started. No obligation! Just MAIL POST CARD NOW! J. E. SMITH, President, Dept. 7MP3, National Radio Institute, Pioneer Home Study Radio School, Washington 9, D. C.



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year's worst blizzard

*When safety's a must  
...it's "Prestone!"*  
ANTI-FREEZE



"Driving an ambulance is al-  
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chances on freeze-ups—I always  
use 'Prestone' anti-freeze!"

*Chester Raffia*



*In your  
car too!*

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NO FOAM...  
NO FREEZE...  
NO FAILURE...**

*One shot lasts all winter!*

**I**F YOU drove an ambulance...  
if lives depended on you...you  
wouldn't have to be reminded  
that "Prestone" is the anti-freeze  
for your radiator.

The weather can shoot up or  
plunge down—"Prestone" brand  
anti-freeze won't boil away...  
you're safe and you know it! That  
peace of mind alone would be  
worth a higher price, but *the  
price has not gone up!* It's still  
the same as before the war!

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